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Review of Environmental Resource Analysis Approaches for LRMP

Prepared for
Ministry of Environment, Lands and Parks

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EXECUTIVE SUMMARY

This document presents a review and assessment of methods used for environmental resource analysis (RA) in selected regional (CORE) and sub-regional (LRMP) processes in British Columbia. The review has been conducted by an independent team of consultants based on a detailed examination of documentation and selected interviews with agency staff. The objectives of this review are to:

- identify the various approaches used for (biophysical) resource analysis and the communication of analysis results in six recent strategic level land use planning processes in British Columbia;
- compare and assess the strengths and weaknesses of these various methods;
- compare and assess the manner in which the analyses were used within the planning process; and
- provide practical guidance to agency staff in undertaking resource analysis for LRMPs.

Resource Analysis in LRMPs

Resource Analysis (RA) provides tools to: (i) identify biophysical resource values and their spatial distribution; and (ii) understand the consequences or impacts of various planning scenarios on those values. Resource analysis consists of:

- gathering, examining and interpreting relevant resource-related information;
- organizing and integrating this information to assist in developing scenarios; and,
- assessing impacts of proposed scenarios on resources and the environment.

The process of resource analysis for specific or identified resources involves answering four basic questions:

1. Where are the areas of importance to the resource?
2. What does the scenario or plan propose to do in each of those areas?
3. When the answers to question 2 have been collated over the whole plan area, what is the impact on the resource? (What level of risk to the resource will exist? Will the resource be sustainable in the long-term? Will the minimum requirements of BC Environment be met?)
4. If the answer to question 3 is "high risk to long-term sustainability" or "no, BC Environment's minimum requirements will not be met", then what actions can be taken to reduce the risk or bring the management regime up to minimum standards?

A typical resource analysis involves inventory work, spatial analysis, the development of indicators, and the generation and management of complex data sets. Resource analysis is therefore generally undertaken by agency staff with assistance from specialist contractors. Often, data is compiled into a Geographic Information System (GIS) to allow for some degree of modeling in the analysis.

There are a number of distinct audiences for the RA:

- non-technical planning table members, who require the information to understand the predicted consequences of various scenarios on biophysical resource values;
- technical planning support staff and contractors, who require the information to prepare a multiple accounts assessment of the significance of impacts under various plan scenarios;
- government decision-makers, who need the information to understand the implications of trade-offs that planning tables may have suggested;
- potentially, the general public during the plan review process, who need the information to understand what impact implementation of the plan may have on the biophysical resources around them; and
- those responsible for implementing and monitoring the plan and undertaking related higher level and operational plans.

Emerging Direction for Resource Analysis

The following table provides a summary of key findings regarding emerging directions in the practice of environmental resource analysis.

Steps in RA	Emerging Direction
1. Identification of issues for analysis	• Identify issues of concern and values of all participants early in the process and link RA to these values to ensure relevance and acceptability • Limit RA to understandable concepts and a limited set of categories and indicators, using keystone or umbrella species to encompass broad issues such as biodiversity
2. Description of analysis methodology	• Ensure that methodologies employed are made explicit, and are explained in a form that is digestible by non-technical audiences • Contribute expert opinion freely, but justify with clear statements of assumptions made and rationale • Limit the number of scenarios considered if possible, to reduce delays, avoid confusion, and minimize costs
3. Choice of analysis categories	• Identify key components or "umbrella" categories to address biodiversity, then provide an overall synthesis discussion of biodiversity in verbal and/or written form • Use habitat categories for analysis (recognizing that this provides opportunities for inclusion of mapped data and a basis for subsequent analysis and discussion) but only if: the assumptions on which the habitat categories are chosen are accepted explicitly; the categories used are reasonable and useful in discerning differences; and results can be linked to broader assessments of impacts on populations. • Use ground-truthing to ensure the credibility of data used for analysis • To the extent that data is not available or is incomplete, rely more extensively on professional opinion providing a clear supporting rationale and acknowledgment of the limitation of this approach. Seek to obtain field data to confirm or modify the professional assumptions where possible

Steps in RA	Emerging Direction
4. Choice of analysis indicators	• Consider use of common sets of indicators in separate sub-accounts (or categories) for analysis: e.g. "feature species indicators" (grizzly, moose, mountain goat), and "habitat indicators" (landscape connectivity, riparian habitat, conservation emphasis). • Where possible, apply a standard set of assessment indicators within each of the sub-accounts used (e.g. human access management, habitat alteration, habitat fragmentation, high value habitat management, and predation pattern alteration) to encourage understanding of the analysis results
5. Linking indicators to impacts	• Keep the following questions in mind when undertaking your analysis: — Does the analysis adequately represent the management option proposed, including realistic assumptions regarding implementation? — Does the analysis address all the key requirements for maintaining the environmental resource at a sustainable level, and if not, are these clearly stated in the assumptions and limitations? — Do the analysis results clearly portray the risks to the environmental resource of proceeding with each of the scenarios examined?
6. Establishment of benchmarks for comparison	• Wherever possible, use benchmarks to provide a basis for assessments of consequences, and to avoid environmental values being overlooked or underrated • Benchmarks should reflect clear goals and an understandable resource value (e.g. maintenance of a species) • State the assumptions and linkages involved in deriving benchmarks when presenting the results of the analysis
7. Choice of approaches to address uncertainty in analysis, assess risk, and set the analysis in context	• State assumptions clearly and seek early agreement/acceptance from the table, particularly with regard to uncertainty and precision of data, the scale of the analysis and the data used, and models or empirical/theoretical relationships (algorithms) used to project and predict future conditions • When presenting results, ensure that the underlying models of ecosystem linkages and systems, problems of interpretation or extrapolation, data gaps, subjectivity and other limitations of the analysis are explicitly stated in a manner that facilitates understanding • Recognizing that contingent information provides critical context for the analysis, ensure that the potential consequences of changes to assumptions within the analysis are explicitly addressed (e.g. continued availability of presently non-operable areas for the maintenance of biodiversity) • Frame the results of the analysis in terms of risk to the sustainability of the indicator (e.g. grizzly bear populations) to ensure that the consequences of proposed management scenarios are fully understood • Avoid statements of limitations and assumptions being used as a disclaimer; instead, state this information so as to provide a foundation for making reasonable statements within the limitations of the analysis methodology

Steps in RA	Emerging Direction
8. Completion of the analysis and assessment of the analysis results	• Where trends are observed, provide an explanation of the causes of the trend and options for management or mitigation • Strive to define the intended outcomes and management strategies to be applied for each scenario • Consider the use of ranking for key polygons or habitat areas to inform discussions, and to provide clear direction for subsequent planning and management efforts
9. Presentation of analysis results	• Place a strong emphasis on the clear communication of results from analysis, including clear statements of the rationale for and consequences of outcomes predicted, together with potential mitigation; one of the key purposes of RA is education • Ensure that the specific activities proposed under various management strategies are linked to the general consequences predicted in the results of RA • Include in the presentation of results: analysis categories selected and rationales; information sources; methodologies employed; indicators used and rationales; assumptions made; limitations of results; and discussion of positive and negative elements of each scenario in providing for mitigation and alternative scenario development • Wherever possible, employ bar graph formats for presentation of RA results, with accompanying text providing explanation and rationales • Use graphics, maps, and where available, photographs to illustrate concepts and to demonstrate predicted outcomes spatially with trends over time
10. Application of the analysis results in the planning process	• Ensure that RA is used to increase awareness of consequences of proposed alternative management strategies • Recognize that RA can and should be an iterative process and ensure that some analysis information is available and utilized early in the planning process so that it does not become simply an "after the fact" review of planning recommendations • Evaluate the timelines and scenario information required to ensure that analysis can be reliably performed without causing delays in the planning process
11. Use of the analysis in plan implementation and monitoring	• Seek to ensure that the RA provides a baseline for future management and planning by: - ensuring that indicators are also developed for implementing and monitoring the plan, and - reviewing and revising analysis methodology and databases as new information becomes available
12. Time and cost considerations	• Ensure that staff and/or contractors that are involved in a resource analysis have time blocks to undertake the task, rather than attempting to "work off the corner of desks" • Experienced contractors can be useful but must work closely with knowledgeable agency staff to be effectively utilized

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APPENDICES

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REVIEW OF ENVIRONMENTAL RESOURCE ANALYSIS APPROACHES FOR LRMP

SALASAN Associates, Dovetail Consulting, Kutenai Nature Investigations

1. INTRODUCTION

This document presents a review and assessment of methods used for environmental resource analysis (RA) in selected regional (CORE) and sub-regional (LRMP) processes in British Columbia. The review has been conducted by an independent team of consultants based on a detailed examination of documentation and selected interviews with agency staff, and other plan participants. This project is managed by a Ministry of Environment, Lands and Parks Steering Committee comprised of Algis Janusauskas (Evaluation and Economics Branch), Marion Bernard (Land Use Branch), Len Vanderstar (A/Senior Habitat Protection Biologist, Smithers), and Brian Turner (Habitat Protection Branch). The authors offer their thanks to the many busy government staff members who provided valuable comments and suggestions to assist with this project. However , liberal interpretation has been made of information and comments received, given the constraints involved in preparation of the report — any errors or gaps in the report remain the responsibility of the consulting team.

1.1 Project objectives and rationale

The objectives of this review are to:

- identify the various approaches used for (biophysical) resource analysis and the communication of analysis results in six recent strategic level land use planning processes in British Columbia;
- compare and assess the strengths and weaknesses of these various methods;
- compare and assess the manner in which the analyses were used within the planning process; and
- provide practical guidance to agency staff in undertaking resource analysis for LRMPs.

1.2 Project scope

The scope of the project is limited to a comparison and assessment of the resource analyses conducted for the following strategic land use planning processes only:

- Kispiox (1991);
- Kamloops (1994);
- Robson (1995);
- Bulkley (1996);
- Kootenay/Boundary (1996 - reviewed the analysis undertaken for the Regional Biodiversity Strategy not the regional CORE plan); and
- Vanderhoof (preliminary draft, March 1996).

These case studies represent a range of resource analyses, from an early effort (Kispiox 1991) to the most recently completed analyses for which documentation was available at the time of writing (see Appendix B). The scope of the review is further limited by a specific focus on *biophysical changes anticipated under various planning scenarios*. Therefore, the review does not examine analyses of the economic or social significance of biophysical changes, which is normally undertaken through a Multiple Accounts Assessment (MAA), nor the inventory or data management undertaken to produce the Base Case against which scenarios are often compared.

Distinct and separate resource analysis procedures have been used in the Timber Supply Review process (TSR) and other levels of land use planning. While the results of this review may provide guidance for TSR and other planning processes, the assessment has been based on case studies of LRMPs and CORE regional level plans only.

1.3 Methodology for the review

The methodology employed for the review is comprised of the following:

(i) A comparison of the resource analyses for the six case studies has been undertaken , based on available documentation prepared as part of LRMP and CORE planning processes. This comparison is presented in table format, derived from the presentation formats of analysis information in the reports.

(ii) Telephone interviews with selected agency staff and consultants responsible for preparing and presenting the resource analyses were undertaken to supplement information gathered from written reports and to gather insights regarding the strengths, weaknesses and effectiveness of each analysis.

(iii) An assessment of the various approaches used for resource analysis has been undertaken, organized around the typical sequence of steps in an analysis process. This assessment is in the form of a commentary on "emerging directions" in resource analyses, based on the assessment of case studies, results of the telephone interviews and the experience of the authors.

1.4 Structure of this report

This report is divided into the following sections:

- Section 2 provides a brief introduction to the purpose of, audience for, and constraints on resource analyses in LRMPs.
- Section 3 presents comparison tables of resource analyses conducted for the six case studies based on a review of documentation and the results of telephone interviews.
- Section 4 summarizes emerging directions based on the review of documentation and key informant interviews.

Appendices are also attached — listing informant interviews and the interview template used (Appendix A) and documents reviewed for the project (Appendix B).

2. BACKGROUND: ROLE OF RESOURCE ANALYSIS IN LRMP

The Land and Resource Management Planning (LRMP) process is a sub-regional, multi-stakeholder planning process for areas between 15,000 and 25,000 km^2. The LRMP process is intended to lead to defined resource management zones and broad management objectives to be fulfilled within each of those zones. The planning process generally involves determining current conditions and the likely future conditions under status quo management (referred to as the base case), developing various planning scenarios based on the issues and values identified for the area and determining a preferred scenario based on an analysis of the various impacts which are predicted to occur.

2.1 Analysis in LRMP processes

There are two distinct forms of analysis undertaken within the LRMP process:

- *Resource Analysis* (RA) provides tools to (i) identify biophysical resource values and their spatial distribution and (ii) understand the consequences or impacts of various planning scenarios on those values; and
- *Multiple Accounts Assessment* (MAA) uses information from the resource analyses to assess the significance of the impacts from an environmental, economic, social and in some cases, First Nations perspective.

The following sub-sections describe these two forms of analysis and explain the linkages between them in greater detail. The resource analysis of environment factors in the LRMP process is in keeping with the mission, principles, goals and strategies identified in the March 1996 Ministry of Environment, Lands and Parks document, *Strategic Direction for Habitat Protection* (see Box 1).

Box 1: Principles and Goals of the Habitat Protection Program

Principles

1. We incorporate into our decisions and actions the ministry's stewardship principle that "living organisms have inherent value, apart from their value and benefit to human society".
2. We view all the natural components of an ecosystem as important and interconnected, and we see our role as protecting the long-term integrity and productivity of that ecosystem rather than viewing it solely as a producer of short-term economic wealth. ("ecosystem management" principle)
3. We recognize the global significance of British Columbia's ecosystems in our management activities.
4. We strive to maintain all functions of ecosystems to ensure a sustainable and diverse environment, and a full choice of resource options for current and future generations.
5. In making management decisions, we apply the best available scientific knowledge, supplemented by professional judgment and the precautionary principle.
6. We strive to provide reasonable, objective reviews of plans and proposals, recognizing that all developments impact ecosystems to varying degrees.
7. We take the strongest stance against long-term irreversible ecosystem change, as opposed to activities that have only a temporary impact that will correct over time and have manageable impacts.

Goals

1. Maintain the diversity of habitats and ecosystems.
2. Maintain threatened and endangered habitats, and the habitats of rare and endangered species.
3. Advocate resource management alternatives that favour ecological integrity.
4. Support, enhance and share an ecological knowledge base.
5. Promote understanding of ecological principles through communication and education.

2.2 Definition of resource analysis

Resource analysis is defined in guidelines for Land and Resource Management Planning as "the critical examination of resources and the environment so as to support planning and decision-making" (see *Resource Analysis Guidelines for Land and Resource Management Planning in British Columbia: Interim Guidelines, Draft, February 1995, Version 2* and *Ministry of Environment, Lands and Parks, Handbook for Land and Resource Management Planning (LRMP)*). Resource analysis consists of:

- gathering, examining and interpreting relevant resource-related information;
- organizing and integrating this information to assist in developing scenarios; and
- assessing impacts of proposed scenarios on resources and the environment (see Box 2).

Box 2: Steps in Resource Analysis

Adapted from page 4, Section 6 of *Ministry of Environment, Lands and Parks Handbook for Land and Resource Management Planning (LRMP).*, prepared by Land Use Branch, December 1995.

1. BUILD THE KNOWLEDGE BASE

This step involves preparing maps, completing inventories, developing indicators and models, determining prediction parameters for the specific resources and generating information on the functional relationships among the various components of biophysical systems. The knowledge base captures the current state and underlying dynamics of the specific resources and how these are affected by management activities

2. ANALYTICAL SUPPORT TO SCENARIO DEVELOPMENT

This step involves identifying what parts of the land base are of importance to specific resources (e.g. which areas can provide habitats for species-at-risk, where the highest value timber resources are). These important areas for individual resources are then examined in relation to one another (using map overlays) to determine where there are compatible and incompatible resource uses. Scenarios are then built around alternative approaches to addressing these conflicts.

3. RESOURCE IMPACT ASSESSMENT

Resource impact assessment involves projecting changes in resources (e.g. changes in biodiversity, hectares of land under cultivation) caused by alternative packages of proposed land use designations and management strategies. Information on anticipated future resource impacts feeds into and provides the basis for an assessment of the significance of these impacts from social, environmental, economic and First Nations perspectives (Multiple Accounts Assessment).

Resource analysis supports the LRMP planning process by providing substantive information for decision-making. There are generally three components of resource analysis (see Figure 1):

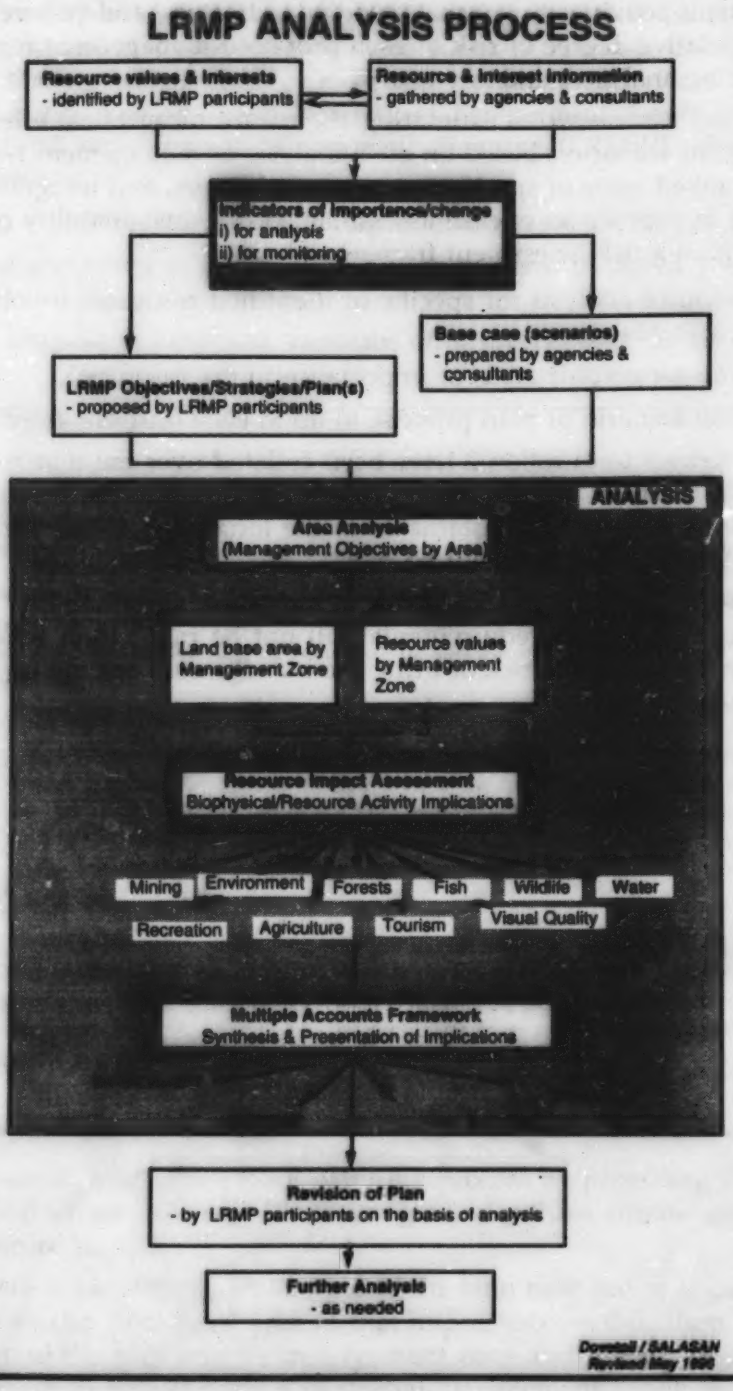
- *area analysis* — identifying what parts of the land base are of importance to specific resources and the degree of that importance — this often involves a breakdown of the plan area by management zone and specific resource indicators (e.g. % critical habitat in special management zone);

- *assessment of proposed management regimes or activities* — identifying where there may be compatible and incompatible proposed management regimes, assessing the potential positive and negative impacts of proposed management or development activities to specific resource indicators, and (where feasible) attaching a relative degree of risk of each proposed management regime to the resources being analysed; and
- *resource impact assessment* — estimating the future biophysical effects of alternative plan scenarios, based on area analysis of management regimes as applied to ranked areas of specified resource indicators, and integrating the area information to provide an overall assessment of the sustainability of each resource (e.g. in a risk assessment framework).

The process of resource analysis for specific or identified resources involves answering four basic questions:

1. Where are the geographic areas of importance to the resource?
2. What does the scenario or plan propose to do in each of those areas?
3. When the answers to question 2 have been collated over the whole plan area, what is the impact on the resource? (What level of risk to the resource will exist? Will the resource be sustainable in the long-term? Will the minimum requirements of BC Environment be met?)
4. If the answer to question 3 is "high risk to long-term sustainability" or "no, BC Environment's minimum requirements will not be met", then what actions can be taken to reduce the risk or bring the management regime up to minimum standards?

Figure 1: A simplified diagram of the LRMP process showing different forms of analysis and the sequence in which they typically occur.



2.3 Context and scope of resource analysis

Resource analysis is important both within and beyond individual planning processes. Effective resource analyses should serve to identify and guide land use and management actions and assist both technical resource managers and non-technical planning participants and members of the public in understanding the consequences of their actions and decisions.

Resource analysis helps to build understanding among planning participants and other non-technical members of the public regarding *what is important* with respect to resources and proposed management actions in a planning area. By identifying the key elements of the biophysical environment in which a land use plan is situated, resource analysis provides the framework for a structured assessment of the predicted consequences of various scenarios considered by the multi-stakeholder planning table. The scope and ability of the RA to faithfully reflect the values of all stakeholders is thus critical — the resource analysis is an essential aid for *informed* decision-making. If the analysis is not accurate, or if it is not clearly presented, then the planning table will face difficulties in understanding the potential impacts that may result from a given set of land use and management actions. As a result, planning participants will be unable to make an accurate assessment of the significance of the changes, and risk committing to trade-offs without due consideration of consequences.

Resource analysis is not necessarily a linear or "one-off" process — LRMP tables frequently revisit elements of the analysis as new information comes to light or as additional issues of concern emerge. RA is thus often used as an *iterative* planning tool, providing insights for potential modification of scenarios or formulation of new options which could reduce impacts to resource indicators.

Another key role of RA is assisting planning participants understand the consequences of *not* planning. Through the development of the base case, RA can identify the impacts (past, current or future) of development on biophysical values and social, economic and environmental conditions in the planning region. In this way, resource analysis provides the critical *reference points* against which the merits of various plans are assessed.

In some cases RA can also identify planning or policy constraints imposed by higher level (e.g. regional) land use plans which may further delineate the scope of acceptable plans for the land area in question.

Finally, RA also includes information which allows planning participants to appreciate the level of *certainty* attached to information. Resource analysis can inform participants of the *reliability, limitations* and *assumptions* behind the analysis results. This supporting knowledge is needed so that balanced trade-offs can be made with an understanding of the potential risks involved.

2.4 Responsibilities for resource analysis and audience for results

A typical resource analysis involves inventory work, spatial analysis, the development of indicators, and the generation and management of complex data sets. Resource analysis is therefore generally undertaken by agency staff with assistance from specialist contractors. Often, data is compiled into a Geographic Information System (GIS) to allow for some degree of modeling of the analysis results.

There are a number of distinct audiences for the RA:

- non-technical planning table members, who require RA information to understand the predicted consequences of various scenarios on biophysical resource values;
- technical planning support staff and contractors, who require RA information to prepare a multiple accounts assessment of the significance of impacts under various plan scenarios;
- government decision-makers, who need RA information to understand the implications of trade-offs that planning tables may have suggested;
- potentially, the general public during the plan review process, who need RA information to understand what impact implementation of the plan may have on the biophysical resources around them; and
- those responsible for implementing and monitoring the plan and undertaking related higher level and operational plans.

To meet the needs of these various audiences, different RA reports based on the same analysis may be required, targeted to technical or non-technical readers and users.

Whatever the audience however, clear communication of the results of the analysis is critical. Careful consideration needs to be given to the choice of presentation format, length and level of detail — to ease interpretation and support appropriate use of analysis results.

2.5 Constraints on resource analysis

Resource analysis attempts to provide consistent and systematic information to allow planning participants to make informed decisions. Therefore, RA attempts to be both comprehensive and appropriately detailed within practical constraints:

- *The budget available for RA is finite.* Undertaking extensive inventories and complex data manipulation is both costly and time consuming. RA has to be targeted carefully to ensure that sufficient information is provided to enable informed decision-making; exhaustive analysis is neither feasible nor necessary in most cases.

- *Time frames available for RA are limited.* RA is intended to provide information to the planning process in a timely manner. Some analysis techniques may be time consuming to undertake, or require field surveys which are constrained by seasonal conditions. Reasonable time frames are needed but the pace of RA should not drive the planning process.
- *The RA may be limited by the availability of technical support* such as GIS or other analysis tools. GIS and computer data analysis are very important tools in meeting the information needs and timeframes of resource analysis within the current LRMP process framework.
- *Analysis may have to be based on existing information.* As a result of limited budgets and tight time frames, much of the RA may need to be based on existing inventory data.
- *The quality of RA is constrained by the level of ecological and environmental systems knowledge.* The current level of understanding of environmental processes and functional linkages will determine the sophistication, accuracy, and precision of analysis — the analyses are only as good as the ecological models and assumptions on which they are based. Knowledge and understanding of natural systems continues to evolve, but there are many aspects of environmental systems, particularly at the regional or landscape scale, which remain poorly understood. However, is it unlikely we will ever fully document environmental process and, therefore, professional judgment will always be critical.
- *The level of detail in the RA may be constrained by lack of appropriate inventory information.* One of the chief purposes of RA is to enable assessment of various management regimes (constraints and/or guidelines) in combinations with different geographic distributions or permutations. Analyses of proposed management alternatives may be limited by lack of inventory information at an appropriate scale or in an appropriate format to provide meaningful analysis predictions. Less detailed analysis, however, can be carried out when given levels of inventory information are combined with local knowledge.
- *The level of detail in the RA may be constrained by communication needs.* The level of detail within the RA is limited by the capacity of planning participants to assimilate technical information and distinguish differences among a potentially infinite number of alternatives and combinations of management actions. Those responsible for presenting RA results have to balance between over-simplification and "techno-babble."

2.6 A note regarding terminology

The terminology used in connection with resource analysis in LRMP processes has not to date been consistently used or standardized. We have attempted within this report to utilize terms within existing "standards of practice" and guidelines, however we have quoted specific terms as used in different analyses in keeping with the context of their original use (e.g. "assessment criteria"). Four general groupings of terms are apparent in current practice, with terms often used interchangeably or inconsistently within or between resource analysis reports:

- *resources* — e.g. biophysical resources (grizzly bears), values (spirituality), interests (maintaining biodiversity);
- *categories* — e.g. accounts and sub-accounts, components, suites;
- *analysis* — e.g. resource analysis, area analysis, impact assessment; and
- *indicators* — e.g. variables, parameters, assessment criteria, species indicators, habitat indicators.

We have not attempted to define these terms within the scope of this report. See the MELP LRMP Handbook for a more complete discussion of terminology, including indicators and types of analysis.

3. A REVIEW OF EXPERIENCE TO DATE

The tables in this section contain the following:

- Table 1 presents a comparison of the resource analyses undertaken for the six case studies based on a review of documented results. The row headings (categories) for the table have been derived from the reports themselves and the table reviews both the format (presentation of results) and the methodologies used for the various analyses.

  Note regarding abbreviations: AOI - Areas of Interest (for PAS), BEC - Biogeoclimatic Ecosystem Classification, Biod - Biodiversity, CWD - Coarse Woody Debris, DFO - Dep't. of Fisheries & Oceans, ECA - Equivalent Clearcut Area, FEN - Forest Ecosystem Network, FPC - Forest Practices Code, FWG - Fish and Wildlife Guidelines, GIS - Geographic Information System, mgmt - management, OG - Old Growth, PA - Protected Area(s), PAS - Protected Areas Strategy, REF - Reference Point for option comparison, RPAT - Regional Protected Areas Team, spp - species, TSA - Timber Supply Area, TSR - Timber Supply Review

- Table 2 presents a summary of interview responses in the form of "messages from the trenches." This table is organized around the typical sequence of steps in resource analysis.

- Table 3 presents a summary of the strengths and weaknesses of each of the six resource analyses based on both the review of documentation and the interviews with key informants (see Appendix A).

Table 1: Comparison of methodology for six resource analysis reports

Category	Kispiox (7/91)	Kamloops (6/94)	Robson Valley (1/96)
Explanation of Methodology	Described in the report; no list of resources	Limited discussion of methods, somewhat confusing use of scenarios; no list of resources	Described in the report; no specific list of resources
Discussion of Analysis Limitations and/or Problems	Limited discussion; includes comment that more detailed information on impacts is required	Limited discussion; DFO mentions limited data and limited knowledge of watershed processes	Lack of information on how habitat will be distributed in various management regimes
Reference Point and Scenario Comparisons	REF: present day or pre-development habitat condition Four options	REF: none (or status quo? - unclear in report) Biod: three or four options Fish: three or four options PA: PAS benchmark vs status quo vs three options	REF: Status quo (base case + FPC + PAS) Two options (Scenario I environmental sectors, and II - industry)
Analysis Categories	Fisheries, Moose, Grizzly, River fishing, Lake fishing	Biodiversity, Anadromous Fisheries, Protected Areas, (Caribou)	Biodiversity, Red/Blue spp, Grizzly, Caribou, Goat, OG dependent spp, Riparian habitats, Ungulate winter range, Fish, Water quality
Analysis Indicators	Habitat alteration, extent of forest harvesting, road density and access, visual landscape modification	Biod: representation in PA, connectivity - FENs, seral stage distribution, rare habitats, OG, critical habitats, stand attributes Fish: wilderness lakes, level of development activity, proximity to habitat PA: BEC representation, size, viability, diversity, meeting other objectives	PA: representation in low risk mgmt. regimes, size and connectivity of PA Grizzly: seral stage distribution, road access, size and distribution of PA, Caribou and Goats: degree of disturbance, Ungulate Winter Range: cover to forage ratios Fish / Water Quality: rate of cut
Functional Linkages between Indicators and Variables	Detailed discussion of linkages between forest harvesting and habitat impacts	Biodiversity section notes that by providing a variety of distributed and linked habitats, ecosystem diversity will be maintained Caribou section includes importance of FENs between known caribou herds	States that relationships between habitat supply models/indicators and population levels are theoretical at best (related to uncertainty involved in analysis)
Risk, Uncertainty and Context	Recognition of need to consider private land in ungulate winter range analysis	DFO: question of private land impacts; cumulative impacts of past development; past lack of implementation and enforcement of guidelines; scale of information is general; lack of watershed sensitivity information PA section discusses need to consider regional context and private land impacts Uncertainty re FENs and PA connections with adjacent plan areas	Ungulate Winter Range and other sections comment on the need to consider private lands; also on the need to consider herbicide treatment restrictions Discussion of other risks to caribou populations
Evaluation Approaches	Qualitative expert opinion	Biod & Fish: mainly qualitative, some quantitative PA: quantitative calculation of representation, qualitative assessment of objectives	Quantitative assessment of GIS overlays of proposed management regimes with habitat maps Qualitative summary of GIS results comparing scenarios

Bulkley (1/95-3/96)	Kootenay/Bndy (5/95-3/96)	Vanderhoof (3/96)
Described in the report; somewhat confusing use of the term "indicator"; no specific list of resources	Described, but somewhat fragmented in a series of reports; complete list of resources	Described in the report; no list of resources
Notes the general lack of inventory data and degree of subjectivity in the analysis; specific lack of lake fish and Red/Blue spp. inventories noted	Identifies limitations due to limited amount and scale of inventory information; states that analysis does not take into account factors other than habitat supply (e.g. population size, disease, etc.)	Identifies potential problems from forest cover data in area estimates of forest land base exclusions; notes the lack of information regarding distribution of habitat within mgmt units
REF: Status quo (base case including FPC) and BC Environment's minimum acceptable mgmt standards Four options and final consensus mgmt recommendation (including FPC + PAS etc.)	REF: BC Environment Benchmark (preferred low risk option) Status quo (TSR) and various options with FPC and PAS	REF: TSR Status quo (TSR+FPC+PAS) and a single option
Landscape connectivity, Tree spp composition, Riparian habitat, Representation (Conservation Emphasis), Grizzly, Caribou, Goat, Moose, Deer, Fish (stream and lake), OG dependent spp	Representation and Connectivity, Caribou, Grizzly, Ungulate Winter Range, Fish,	Representation, OG, Connectivity, Moose, Marten, Grizzly, Red-listed (Caribou)
Human access mgmt, habitat alteration, fragmentation, mgmt of special and/or high value habitats, predation pattern alteration, forage and browse production, cover, conservation/protection	Representative ecosystems, and regional connectivity (e.g. linkage corridors between PAs), caribou habitat mgmt (OG, lichens, connectivity, access), ungulate winter range mgmt (cover/forage ratios, range condition, browse quality, access), grizzly habitat mgmt (access, special habitats, seral stage distribution), fish habitat, riparian and watershed mgmt (ECA, riparian, road density, flow regimes)	Representation of biogeoclimatic subzones/variants in various land use categories, area maintained at an old seral stage (old growth representation), size and connectivity of protected and low intensity resource development areas, distribution of mgmt regimes, access control, road density, vegetation mgmt
General discussion of linkages as an introduction to each category; simple and clear charts presenting key habitat factors for each analysis category	Discussed generally	Stated that relationships between habitat supply models/indicators and population levels are theoretical at best
Recognition of need to consider: private land in analysis, especially for ungulate winter range; adjacent TSAs for grizzly mgmt; hunting regulations Lack of decision regarding the establishment of Enhanced Timber Areas Notes uncertainty around site specific implementation of FENs	Enhanced timber areas are not yet designated Analysis includes potential impacts of management of private lands	Discussion of proposed PAs in adjacent LRMP areas to provide regional context Importance of private lands is noted for moose and representation categories
Qualitative assessments and descriptions Some quantitative GIS overlays (although very little quantitative data is available in the report)	Quantitative assessment of GIS overlays of proposed management regimes with habitat maps Qualitative assessments of mgmt regime compatibility Semi-quantitative summary of GIS results comparing scenarios	Quantitative assessment of GIS overlays of proposed management regimes with habitat maps Qualitative summary of GIS results comparing scenarios

Category	Kispiox (7/91)	Kamloops (6/94)	Robson Valley (1/96)
Stated Analysis Assumptions	Forest practices of 1985-89 were normal practices representative of the base case or status quo	Biod: habitat alteration as a substitute for spp population analysis; preference for diversity of seral stages, non-fragmented unroaded large habitat blocks; FPC (Biodiversity Filed Guide) and FWG will meet biodiversity needs Fish: habitat alteration as a substitute for spp population analysis; development disturbance has adverse impacts; various land use designations vary in degree of impact risk; fish values in lakes protected through Regional Lake Classification guidelines applied through Forest Development Planning procedures PA: need to capture full range of diversity in PA	Habitat supply and structure as a substitute for spp analysis Increasing FPC biodiversity emphasis classes (from low to high) have increasing abilities to meet most spp needs FPC guidelines would be effectively implemented RPAT AOIs will in fact become PA Riparian habitats will be adequately protected by FPC Present caribou guidelines will remain in force and adequately protect caribou
Spatial Categories for Presentation of Results	Whole plan area Written discussion of some valleys; graphic results by subunit for fish	Biod: whole plan area Fish: by watershed for PA and caribou habitat guidelines PA: by ecosection and BEC unit	Generally whole plan area Representation by BEC unit and ecosection Some discussion of habitat by valley and landscape units
Direction for Mitigation and/or New Scenario Development	Specific mitigation recommendations to minimize impacts on environmental resources	No specific direction, but some implied Range enhancement fund subsequently recommended by the planning Table	Direction given in discussion
Linkage to Implementation and Monitoring	No discussion	DFO discusses the need for monitoring and follow through in implementation	Discussion of the need for future research and monitoring to verify habitat/population models
Costs, Time and Resources	Minimal - almost strictly expert opinion and qualitative judgment	Moderate - mainly expert opinion, but some quantitative information generated by GIS overlays	High - extensive GIS habitat overlays and in-depth analysis of results
Transferability of Methodology	Yes - especially where data is very limited	Not easily; somewhat ad hoc reflecting option building	Yes - if GIS capability and level of inventory information is available
Presentation Format	Written and some graphs With regard to fish make clear statements about degree of impact No summary	Mainly written, with some tables in Fish Fragmented with no consistency between categories or sectors No overall summary of results	Mainly written with tables Comparisons of options are made only relative to each other, not in degree except in grizzly bear Results are never summarized, except in Appendix

Bulkley (1/95-3/96)	Kootenay/Bndy (5/95-3/96)	Vanderhoof (3/96)
FPC and Landscape Unit plans will meet the needs for grizzly bear habitat management	Habitat supply and structure as a substitute for spp analysis Increasing FPC biodiversity emphasis classes (from low to high) have increasing abilities to meet most spp needs; that PA would be managed at high emphasis Biod or better FPC guidelines would be effectively implemented	Habitat supply and structure as a substitute for spp analysis FPC Biod. Emphasis classes are equivalent to Low, Gen. & High development intensity; Settlement/Agric is equivalent to Low Emph Biod FPC Biod. Guidelines will be fully implemented Increasing FPC biodiversity emphasis classes (from low to high) have increasing abilities to meet most spp needs
Discussions of subunit planning areas and specific valleys with regard to positive and negative aspects of scenarios; but generally whole TSA	Results by Ecosections Results by BEC units, subregions and general habitat types for representation Caribou: results by six defined populations	Results by Ecosections and BEC units for representation, but others by total plan area Some discussion of results by Resource Management Zones
Detailed discussions of positive and negative aspects of scenarios which provides direction for potential mitigation strategies or scenario amendments	Some discussion in point form of main limiting factors	Discussion provides insights into main limiting factors
Need for ongoing monitoring and adaptive mgmt noted	No discussion	No discussion
Moderate - Use of GIS and capability maps, but the extent is unclear from the report	Moderate - High A sequence of analyses to compare a series of options; extensive use of GIS overlays	Moderate - High Extensive use of GIS overlays
Yes - but not enough information in report to fully document methods	Yes - if sufficient habitat inventory exists and GIS resources are available	Yes - if sufficient habitat inventory exists and GIS resources are available
Written with graphs and some tables No summary of results	Mainly graphs with point form text and written description of methods; tabular summaries of key information	Text with some tables and graphs Very general summary in MAA, and general landscape level overview summary in analysis

Notes: AOI - Areas of Interest (for PAS), BEC - Biogeoclimatic Ecosystem Classific'n, Biod - Biodiversity, CWD - Coarse Woody Debris, DFO - Dep't. of Fisheries & Oceans, ECA - Equivalent Clearcut Area, FEN - Forest Ecosystem Network, FPC - Forest Practices Code, FWG - Fish and Wildlife Guidelines, GIS - Geographic Information System, mgmt - management, OG - Old Growth, PA - Protected Area(s), PAS - Protected Areas Strategy, REF - Reference Point for option comparison, RPAT - Regional Protected Areas Team, spp - species, TSA - Timber Supply Area, TSR - Timber Supply Review

Table 2: Summary of interview responses: "messages from the trenches"

An assessment of the resource analysis undertaken for the six case studies is presented in table form below. The assessment of resource analyses is organized around the sequence of decision steps in a resource analysis, as follows:

(i) Identification of issues for analysis
(e.g. what key issues were identified in the scoping phase of the LRMP, and by whom?)

(ii) Description of analysis methodology
(e.g. what combination of expert opinion, overlays, and GIS was used, and how was qualitative/quantitative information incorporated into the analysis?)

(iii) Choice of analysis categories
(e.g. what categories were chosen, why, and by whom?)

(iv) Choice of analysis indicators
(e.g. what indicators were selected, why, and by whom?)

(v) Establishment of benchmarks for comparison
(e.g. what baselines or benchmarks were established against which scenarios were evaluated, and how were these baselines or benchmarks established?)

(vi) Choice of approaches to address uncertainty in analysis, assess risk, and set the analysis in context
(e.g. how were questions of risk (long term viability), uncertainty, and context addressed?)

(vii) Completion of the analysis and assessment of the analysis results
(e.g. what are the linkages between analysis indicator and variables that underpin the analysis and how were these linkages determined and articulated?)

(viii) Presentation of analysis results
(e.g. how and when were the analysis results presented?)

(ix) Application of the analysis results in the planning process
(e.g. to what extent did the analysis results influence discussion and decisions?)

(x) On-going use and adaptation (revision) of the analysis
(e.g. was the approach adopted sufficiently flexible to allow for the on-going use of the analysis in subsequent scenario development or plan implementation?)

Additional issues considered in the assessment include the following:

- the costs, resources and time involved in the analysis; and
- the transferability of the approach adopted.

See Appendix A for a list of interview respondents and the interview template.

Table 2: Summary of interview responses

Steps in RA	Comments on Methodology	Comments on Use/Acceptance in the Planning Process
Overall Comments	RA is best done at an overview level for this level of planning — need to get participants away from a focus on "itty-bitty pieces of ground" to looking at the "big picture" RA is a critical analytical tool for assessing both the consequences of following a set of management actions (scenario analysis) and identifying the inventory, management and monitoring needs to be applied at other planning levels (e.g. at landscape unit and operational planning levels) RA has three purposes: 1) to inform LRMP participants of the consequences of alternative actions during the discussion/negotiation phase of the planning process; 2) to ensure buy-in from the participants of the consensus recommendation; and 3) to provide benchmarks and references for future planning processes in determining and testing appropriate management actions and assumptions.	To be effective, RA for environmental issues has to provide information that gains the same level of acceptance and credibility as other analyses (in particular, the timber supply analysis) — this means that considerable effort must be spent early in the planning process to build buy-in on methods and subsequently to communicate and ensure an understanding of analysis results regarding threshold benchmarks and assessment of risk to populations or other indicators Acceptance ultimately boils down to trust of the professionals involved in the RA process — clear explanations of approaches, assumptions involved and findings help to build this trust
1. Identification of issues for analysis	Issues were derived from the knowledge and values that were brought to the table (including BCE's statement of interests) Public issues came down to old trees, water quality and access — all are mappable; RA subsequently tied these issues to broader indicators (e.g. species populations) and specific analysis methods (e.g. wildlife habitat capability)	RA needs to be tied to issues identified by the planning participants, otherwise it will be seen as irrelevant
2. Description of analysis methodology	"Frontispiece" to the analysis is important, outlining rationale behind the analysis and setting the stage for acceptance of the analysis results Appropriate inventory and working GIS methodology is key to effectiveness of subsequent RA — need to start work on compiling this long before RA is scheduled to begin, the main difficulties are not interpretation but in obtaining useful inventory information to interpret Need enough ground-checking of information (e.g. habitat capability mapping) to ensure credibility and usefulness of RA — this can be done by checking maps produced using habitat assumptions against local and/or professional knowledge of actual wildlife use	Numbers around the RA did not really influence negotiations, however, expert opinion does have an influence on negotiations and the more accepted and reasoned it is, the more influence it has Often Tables call for detailed information that doesn't get used — general ratings of importance (e.g. Low, Med, High), provided that they are credible and are related to the issues of importance to participants, are the most effective

Steps in RA	Comments on Methodology	Comments on Use/Acceptance in the Planning Process
2 con't	Key is utilizing information at a level of detail that is sufficient to be credible and useful, both within and subsequent to the planning process, yet not so detailed that public members get lost Need to keep the methodology clear and simple, e.g.: - there is/was/could be grizzly bears here in low/med/high numbers; - these are the habitat needs of the grizzly bear; - these are the influences on grizzly bear populations; - here is where there is good/key habitat for grizzly bears (L, M, H); and - the proposed management scenario raises/maintains/lowers grizzly bear population to this degree, for these reasons Habitat capability overlays are used extensively during development of management scenarios and are also key to the RA — habitat capability maps from Victoria (1:250,000) provide a starting point but need to be refined and modified on the basis of local knowledge and more detailed information to be effectively used in the RA Habitat-based approaches to analysis are what we must rely on (this is land use planning after all) and are useful as long as they are justifiable (i.e. based on accepted assumptions), reasonable (i.e. not all high and good) and linked to broader assessment of impacts on populations If there is no data at present, then make a professional opinion based on the extent of information available (literature review and local knowledge) and then go out to get the data which will either confirm or modify the professional assumptions (in the implementation and monitoring of the plan) — this process is no different that what is done in determining Growth and Yield curves for tree species	A common weakness for BCE is not enough of the right kind of information for this type of strategic level planning — the methodology chosen must recognize the nature of the available information and draw on sources (often local or expert knowledge in combination with habitat or management activity information) in a systematic enough way to ensure acceptance at the planning table Expert opinion, expressed at the table in a manner understandable to participants, held more sway than a RA with a "bunch of fuzzy numbers" When expert opinion was presented and accepted as not "just guessing" then it was a lot more credible

Steps in RA	Comments on Methodology	Comments on Use/Acceptance in the Planning Process
3. Choice of analysis categories	Influenced by three factors: government direction (e.g. BCE Strategic Plans — Grizzly Bear Management Strategy, PAS goals and targets); issues raised by planning table(e.g. biodiversity); and available data (e.g. wildlife habitat information) Used two sets of accounts — "feature species" (e.g. grizzly bear, mountain goat, moose) and "habitat indicator" (e.g. landscape connectivity, riparian habitat, conservation emphasis) Number of categories for assessment is important, too many categories will lose meaning to participants, however you want to be able to "paint an overall picture" — suggest 10-15 categories maximum	Setting out options according to "issues/scenarios" (Kamloops) did not really help participants — difficult to assess alternatives and "fuzzy mixes"
4. Choice of analysis indicators	Choice is limited by time and data available Key is basing analysis on mappable parameters (e.g. ecosystem representation, biogeoclimatic subzones, identifiable riparian ecosystems, Conservation Data Centre habitat criteria for Red and Blue listed species, provincial caribou habitat guidelines) and then attaching management guidelines to those mappable units Easier to attach numbers to habitat indicators than to key or feature species populations, however, important to do both (feature species will be more on the basis of professional judgment) Attempting to identify or build a biodiversity indicator was too difficult and fuzzy — instead used feature species and habitat indicators to develop a broad brush picture of biodiversity, if desired a written commentary on biodiversity could then be derived	Indicators have to reflect what people have some knowledge and care about, therefore often surrogate indicators are needed to bridge between participant understanding (e.g. wildlife habitat) and longer-term broader needs viability and sustained biodiversity In the Bulkley, we tried to keep the same assessment criteria (indicators) across as many accounts as possible in an attempt to increase understanding of the RA (e.g. for all feature species accounts used human access management, habitat alteration, habitat fragmentation, high value habitat management and predation pattern alteration)

Steps in RA	Comments on Methodology	Comments on Use/Acceptance in the Planning Process
5. Establishment of benchmarks for comparison	Need to be able to trace back to clear goals and an understandable resource (e.g. maintenance of a species) BCE needs to determine environmental threshold benchmarks for use in the RA — MOF has a forestry benchmark in the TSR, if BCE doesn't do the same then it is like "working with one arm tied behind your back." A threshold benchmark is associated with assessed risks to the ongoing sustainability or viability of the indicator (e.g. specific wildlife populations or herds), it is not an environmental ideal or preferred alternative In Bulkley, used "BC Environment's Acceptability" and explained criteria utilized in establishing that level — using an "assessment of risk" or "environmental thresholds of risk" instead could be a good way to get away from challenges regarding just what is an acceptable level of change	PAS targets are an example of targets or benchmarks — initially they were challenged or rejected by participants but when government's direction was finally accepted, the percentages provided the table with a useful framework to work within Downside of comparing alternative scenarios to a BCE benchmark or "preferred alternative" is the challenge that BCE may be trying to unduly influence discussions — if the comparison is presented as the consequence of a set of proposed actions rather than as a judgment, it is less subject to criticism (e.g. "there is a high risk of extirpation of grizzly bear populations in x, y and z watersheds under Scenario A" rather than "logging is not acceptable in x, y and z valleys because of risk to grizzly bears")
6. Choice of approaches to address uncertainty in analysis, assess risk, and set the analysis in context	Statements regarding assumptions and uncertainties should reinforce the credibility of the RA results and confidence in the information and judgments that are made as part of the analysis (instead, many of the RAs use these statements as disclaimers decreasing the credibility and influence of the RA) Important to be open about the uncertainties involved in the RA, a clear explanation of the analysis limitations to planning participants will build trust in the overall analysis Need to get agreement from the planning table on assumptions being made in the RA (e.g. Low Biodiversity guidelines will have a higher risk to grizzly bear populations) It is difficult to find situation where you can say: "if you do this (e.g. build a dam), then this would be the result (e.g. loss of a population)" Framing analysis around statements of risk provides a good context for consideration of the results	Analysts are often reluctant to make assessments of long term risk to specific indicators (e.g. species populations) on the basis of one set of management strategies and assumptions because the high degree of uncertainty and wide range of other factors that may be critical for long term viability, however, it is this assessment that most planning table participants are looking for and will accept if set out in an understandable fashion Lack of data was, and continues to be, a key problem — there remains among participants some discomfort around the quality of data that was used in the RA and the extrapolation that then was needed Participants will accept or acknowledge unknowns if provided in context which also allows reasonable choices to be made

Steps in RA	Comments on Methodology	Comments on Use/Acceptance in the Planning Process
7. Completion of the analysis and assessment of the analysis results	Details of the proposed management regimes for each scenario help to make the RA more useful and reduce the number of assumptions that have to be made (e.g. in the Bulkley, the level of detail around proposed forest connectivity corridors and lake access enabled a more objective assessment and modeling of alternative scenarios) RA should provide a ranking of key polygons/habitats for key indicators in order to inform the analysis discussion and assessment (e.g. the 1-20 top ranked ungulate winter range habitat polygons) — this information can then be linked to more detailed management prescriptions at lower levels of planning We're improving in getting at spatial characteristics but the next step that is needed in RA is analysis of temporal changes (e.g. "habitat response curves" over time based on different management regimes)	Table will accept results if the assumptions are understood, the figures are clear and the results intuitively make sense When a trend was noted (either upward or downward) we always tried to show or explain why (e.g. if there is an impact on the indicator, what can be done to mitigate it or what could be done differently to avoid it) RA provides information regarding choices and consequences of different choices, not statements (e.g. these are the consequences on these indicators of logging this area in this manner, not "logging shouldn't take place here")
8. Presentation of analysis results	Part of the role of RA is to educate the planning table members on the issues involved and the pros and cons of alternatives Most important to participants are the links between management strategies and the final results of the RA — what are the consequences of following a particular management strategy? Participants need to know the overall trends in the indicators that result from the proposed management strategies and why those trends look the way they do (i.e. why is there a declining trend and what can be done about it?) — graphs plus discussion is needed Set out RA for each indicator in this way: - indicator (and why chosen); - methodology used (e.g. habitat capability mapping); - analysis assumptions (used to assess impacts of alternative scenarios); - areal distribution (e.g. how much of each habitat class in each management regime under the scenario); followed by discussion In the process of developing the Kootenay Biodiversity Strategy, we have produced over 7,400 maps with different overlays and permutations — this has been synthesized down to a set of 10 overlays for presentation and lay use	Communicating the RA to planning participants is key to its effectiveness — has to been done in ways that are meaningful to the people involved (e.g. an assessment of risk to a species population has more meaning than population numbers or "minimum viable population" calculations) Most useful are trends with accompanying explanations Photos are useful to illustrate concepts (e.g. greenup stages, alternative management practices, different habitat types, rare ecosystems, etc.) and, if available, to show changes over time (e.g. time series photos of a particular area) Bar graphs enable presentation of differences between scenarios on a watershed or landscape unit basis

Steps in RA	Comments on Methodology	Comments on Use/Acceptance in the Planning Process
9. Application of the analysis results in the planning process	RA not really used (Robson) — came too late in the process, however, participants have a gut feeling about what the impacts are even without the RA Held back presenting RA results until later in the planning process so participants did not use the RA to fight over each RMZ — RA more useful once objectives and strategies for each RMZ are agreed upon based upon the character of the area, not the impacts of the choices In the Kootenays, we didn't really have final plans, instead we had to work within the government decision regarding the results of CORE and within the planning bounds that we have been given (e.g. % impact limits on timber harvesting) — the Biodiversity Strategy (RA) provides an analytical tool to assess the consequences of following those bounds, to identify high ranking areas for specific environmental attributes and to identify where biodiversity will and won't be managed for	The RA was not used (Kamloops), different parts of the table refused to accept it and in the end we relied on negotiations — can't get to a level playing field through RA RA impact information often arrived too late to assist the negotiations; however, at a minimum, the RA provided a comfort level among participants that a balanced plan had been achieved
10. Use of the analysis in plan implementation and monitoring	The LRMP level provides the skeleton with the implementation and subsequent effort at more detailed scales left to "flesh it out" — the RA also provides a framework to assess whether or not the intended objectives are met and the assumptions around intended management actions hold true Data set can be enhanced for use in subsequent planning processes, methodology has been refined and can be replicated now with less cost (e.g. same consultant can undertake upcoming RAs without the learning curve associated with early processes)	

Additional Comments from Respondents	
Water Quality and Fisheries	These areas were not necessarily well covered or addressed in the RA For the most part dealt with water quality at the level of objectives and management strategies; does not lend itself readily to RA on an area basis (in contrast to wildlife habitat) Fisheries not really considered in detail, not much appropriate information available Fisheries information was almost completely lacking (Vanderhoof) Fisheries impact assessment was done on a watershed by watershed basis by a professional assessment of impacts based on: 1) the physical character of the watershed; and 2) the proportion of the sub-basin or watershed in various land use categories (e.g. High Intensity, Special Mgt., Settlement) Can use road density, Equivalent Clearcut Area (ECA) and recommended management practices to assess impacts on both water quality and fisheries — much of this is laid out in the Code, hazard is that the Code becomes the driver for planning, rather than the planning setting direction for application of the Code Developed a concept of a "fisheries unit" to assess the relative impact of scenarios on a watershed basis Water has not really been well considered in RAs to date and will be more important in some upcoming LRMPs (e.g. Okanagan)
Role of Contractors Relative to Government Staff	Need effective participation of both MELP staff and use of contractor(s) — enough staff time to provide initial analysis material (e.g. habitat capability mapping) and local knowledge/expert opinion, contractor with enough direction to "draw the lines" and bring a defensible set of information to the Table It is important that the RA not just be a one-person effort, whether that person is a contractor or staff, joint development and input from several sources increases support and strengthens the RA Presentation of analysis, assumptions and assessment by contractor, even though done under BCE supervision, assisted in participant acceptance of results Contractor can ease the burden of RA on staff but still need thorough understanding of methodology, support and supervision of contractor(s) on the part of staff

Additional Comments from Respondents	
Costs and Time Involved	The initial iteration of the RA probably involved about 6 to 10 days of time (Bulkley) — with good local knowledge, a clear methodology and appropriate information available, it could be done in 5 days if a block of time is allocated for the task, rather than attempting it "off the side of the desk" In the Bulkley, we had little access to GIS — its use can be more time consuming but should result in a product that is more rigorous and useful beyond the life of the planning process In the Kootenays, we have spent about $50,000 and 1/2 an FTE developing the Regional Biodiversity Strategy, involving also time from a full range of MELP staff to ensure accuracy and support — this effort has a purpose beyond that of a RA, it is an analytical tool for assessing the consequences of meeting government set targets (e.g. timber volumes) and for more detailed levels of planning (e.g. landscape unit planning) — the strategy is also tied to a GIS based set of information that allows identification and ranking of specific areas based on habitat types or other attributes Time for peer review and modification as a result of comment is also important for buy-in among MELP and other government staff and increases credibility of the RA At present, have as little as 6 days of contractor time to undertake a RA — very little of lasting effect can be accomplished within this limit, and what is done is heavily dependent on provision of good information by government staff — suggest that about 10 days is needed The Robson Valley RA took about twice as long as was initially estimated (20 days +) due to information gaps and development of methodology (hopefully, we have gone through the learning process now)

Table 3: Summary of evaluation comments for the six resource analysis reports

Reports	Strengths, Weaknesses and Experience
Kispiox (7/91)	This analysis was completed before GIS analysis and detailed information on habitat capability were available. This analysis was based primarily on expert opinion and experience, with almost no presentation of background data. **Strengths:** • use of graphs and written discussion for presentation of analysis results • discussions of short, medium and long term implications of the plan scenarios • discussion of context in terms of linkages between past practices and habitat loss • linkage between analysis assumptions and results of management strategies (e.g. est. % loss of fish habitat carrying capacity) • identifies actions that could be taken to mitigate downward trends or impacts • clear concise descriptions of relevant aspects of management guidelines for each scenario **Weaknesses:** • difficult to link with actual management strategies and to assess management strategies at more detailed planing levels • results are dependent on expert local knowledge and are not likely to be reproducible; lack of backup data may be less acceptable in today's GIS world • provides no objective baseline for future monitoring • no discussion of limitations **Experience:** • used within the limitation of data availability; high degree of acceptance • low cost
Kamloops (6/94)	**Strengths:** • discussion of the planning context with regard to past practices and the need for links to the implementation phase (anadromous fish section) • background discussion of categories and theoretical basis for analysis **Weaknesses:** • written presentation is uneven and incomplete; some categories and scenarios are missing from sections of the report; lack of graphic summaries of results • little discussion of methods, limitations or information base • some assumptions that may not be true (e.g. FPC will protect all aspects of biodiversity) • no independent reference point **Experience:** • not really used, not accepted by the planning participants • utilization of "issue scenarios" created fuzzy and complicated alternatives that were difficult for participants to understand

Reports	Strengths, Weaknesses and Experience
Robson (1/96)	**Strengths:** • extensive presentation of background information and area analysis data • description of indicators and assumptions used for each analysis category • presentation of relative risk assessment for comparison of grizzly mngmt options • treatment of red- and blue-listed species (use of qualitative assessment based on expert opinion) **Weaknesses:** • presentation of area summary results in complex tables with no graphs • lack of conclusions regarding absolute impacts or risks to species or populations based on the area summaries (except grizzly bears) • no independent reference point or discussion of planning context • use of land use designations - timber harvesting land base, forest exclusions, non-forest exclusion - which are complex to understand and may result in misleading conclusions (e.g. grizzly habitat in all scenarios is 45% in non-forest exclusions which include private land, non-forest types and roads; if it is mostly roads and private land the conclusions are quite different than if it is mostly alpine and wetlands) • some assumptions that may not be true (e.g. FPC will protect all aspects of biodiversity, that forest exclusions are somehow permanent reserves, areas of interest will become PAs) • no discussion of limitations **Experience:** • not really used other than to provide comfort with consensus direction — arrived too late in the process
Bulkley (1/95 - 3/96)	**Strengths:** • discussion of positive and negative elements of each scenario for each analysis category which provides a basis for mitigation and alternative scenario development • use of independent reference point for comparison (BC Environment minimum acceptable management level) • clear and concise summary of methodology • discussion regarding inoperable areas (older conifer forest dependent species) **Weaknesses:** • weighting scale may be misleading in that many would assume "0" scores to have no impact in relation to "+" and "-" scores; it is not clear why BC Environment's minimum level of acceptability for deer is 90% of optimum and the minimum for caribou is only 60%) • using reference point as "absolute minimum objective" rather than low risk management as an objective (e.g. in the consensus scenario caribou is almost at the minimum level objective, but text indicates a high risk of extirpation) • lack of category to deal with ecosystem representation (i.e. gap analysis by management regime) • lack of consideration given to planning context (e.g. discussion of influence of private land in ungulate winter range section) • assumptions that may not be true (e.g. Prov. Grizzly Strategy will protect grizzlies) • no discussion of limitations **Experience:** • effective use in planning process, largely provided a comfort level among planning participants around the consensus management direction

Reports	Strengths, Weaknesses and Experience
Kootenay/ Boundary (5/95 - 3/96)	The Kootenay/Boundary example involved a "Regional Biodiversity Strategy" which was prepared following completion of the regional plan. This material was intended for use by MELP and MOF staff - not for use by general public or planning table. **Strengths:** • use of independent reference point for comparison of scenarios (BC Environment benchmark of low risk management) • spatial resolution of results (e.g. by ecosection, by caribou population) • adaptation and selective use of inventory information appropriate for the scale of planning; provincial capability information was updated through review by local specialists • documentation of inventory data and information sources • consideration of planning context including private land and past development impacts • presentation of assumptions and methods • concise tabular summary of relevant management regimes for each scenario **Weaknesses:** • methodology is moderately complex and requires adequate GIS and data analysis capabilities • presentation is short on verbal explanation and is disjointed due to being a series of reports, none of which stand alone **Experience:** • provincial objectives and bounds related to maximum impacts on the AAC have had the most effect on shaping the regional plan , rather than any environmental resource analysis to date • provided MELP with interactive feed-back for revision of various scenarios and minimizing negative environmental impacts within prov constraints
Vander-hoof (draft 3/96)	**Strengths:** • clear presentation of indicators, analysis criteria and assumptions • presentation with a mix of graphs, tables and written discussion • selection of categories for analysis: balance of ecosystem representation, landscape features and individual species of concern **Weaknesses:** • assumptions that may not be true (e.g. private land equivalent to FPC low emphasis biodiversity, forest exclusions are somehow permanent reserves, areas of interest will become PAs) • lack of consistency and clarity in graphs and other data presentation • emphasis on timber harvesting landbase; use of forested and non-forest exclusions may have limited relevance to habitat or ecosystem functions • no independent reference point or discussion of planning context • lack of spatial resolution within the planning area **Experience:** • RA held back in the process due to lack of availability of environmental analysis and concern that interpretation would be biased towards available (e.g. timber) information • RA provided when table had already reached preliminary consensus agreements; used to ensure that participants felt comfortable with the balance of the agreement they had struck

4. CONDUCTING RESOURCE ANALYSIS: EMERGING DIRECTION

Based on the comparison and assessment of the resource analyses and the results of interviews with practitioners above, the following section summarizes emerging direction and advice regarding resource analysis (RA) and highlights some key factors to be considered when conducting an analysis. Recommendations for practitioners are provided at the end of each sub-section and are summarized in a table in the Executive Summary to this document.

4.1 Identification of issues for analysis

The resource analysis needs to be tied to "things that are important" to participants (both government and public) in the planning process. Work done early in the process to clearly identify the values and interests of table participants will help to guide the RA and ensure that time and money invested in the RA will support planning discussions and recommendations. The RA will have to address large, complex and nebulous issues such as "biodiversity" within limitations of time, expense and knowledge. Planning participants need to be aware and supportive of the manner in which the RA identifies and addresses these issues. Rather than attempting a broad sweep of all possible issues, the RA should be targeted and closely linked to understandable concepts, categories and indicators. Identification and selection of limiting factors and "keystone" or "umbrella" species can be useful in reducing the number of categories necessary to assess overall impacts on environmental values or complex values such as biodiversity.

The level of detail of the resource analysis will be determined by available information and tools (e.g. resource inventories, GIS support). If data is not available or very limited (as in the case of the Kispiox LRMP), it is still possible to provide a general level of assessment with "pointers" to participants regarding trends, areas of concern and possible management directions.

Recommendations: Begin early — before the planning process is too far along !! Work with planning participants to ensure that the resource analysis will be both relevant and doable.

4.2 Description of analysis methodology

An explanation of the methodologies employed in the resource analysis needs to be provided to allow planning participants a full appreciation of the scope and nature of the work undertaken. This information is also important for technical staff interested in replicating or further developing the analysis or implementing monitoring programs subsequent to the planning process. A listing of resources should also be included as part of the RA. Both qualitative and quantitative methods of assessment are used in resource analyses methodologies (see Box 3, below). The approach adopted should be made explicit, to ensure that planning table participants understand what information is derived from empirical data, the nature of mapped information and how this information is refined through expert judgment and analysis methods.

Box 3: Comments on Qualitative and Quantitative Analysis

Adapted from: *LRMP Handbook*, Ministry of Environment, Lands and Parks, 1995

Quantitative analysis uses numerical measurements to describe conditions, relationships and trends.

Qualitative analysis involves describing conditions and relationships based on existing scientific research, experience and judgment. Qualitative analysis generally relies on words rather than numbers, although rating scales may be used (e.g. "very good" to "very poor" conditions can be translated into a +2 to -2 rating scale, while still being fundamentally qualitative).

Both types of analysis have a role to play. Environmental analysis relies heavily on professional judgment to deal with complexities and uncertainties of subjects, such as biodiversity.

Most analysis is neither purely quantitative nor qualitative. For example, a qualitative analysis of biodiversity is based in part in some numerical measurements (e.g. number of rare and endangered species).

Generally a good qualitative assessment is better than a poor quantitative one. Experience suggests that most tables will accept the results of qualitative analysis if the reasons behind the assessment are explained. Translating limited data into quantitative statements often faces serious criticism.

Analysis methodology should be clear and simple and presented in a concise form so as to be readily understood by a non-technical audience (see Box 4 and Figure 2 below).

Expert opinion, expressed in an understandable format, is more valuable and more likely to be accepted than detailed quantitative analysis which is not supported by explicit assumptions or rationale. It must be remembered that even quantitative analyses are based to varying degrees on assumptions and expert opinion. Algorithms based on assumptions and extrapolated data are involved in habitat capability modeling and population assessments, just as they are in timber growth and yield modeling. Finally, one piece of summary advice from practitioners regarding choice and explanation of analysis methodology — "remember, it is better to be generally right than precisely wrong."

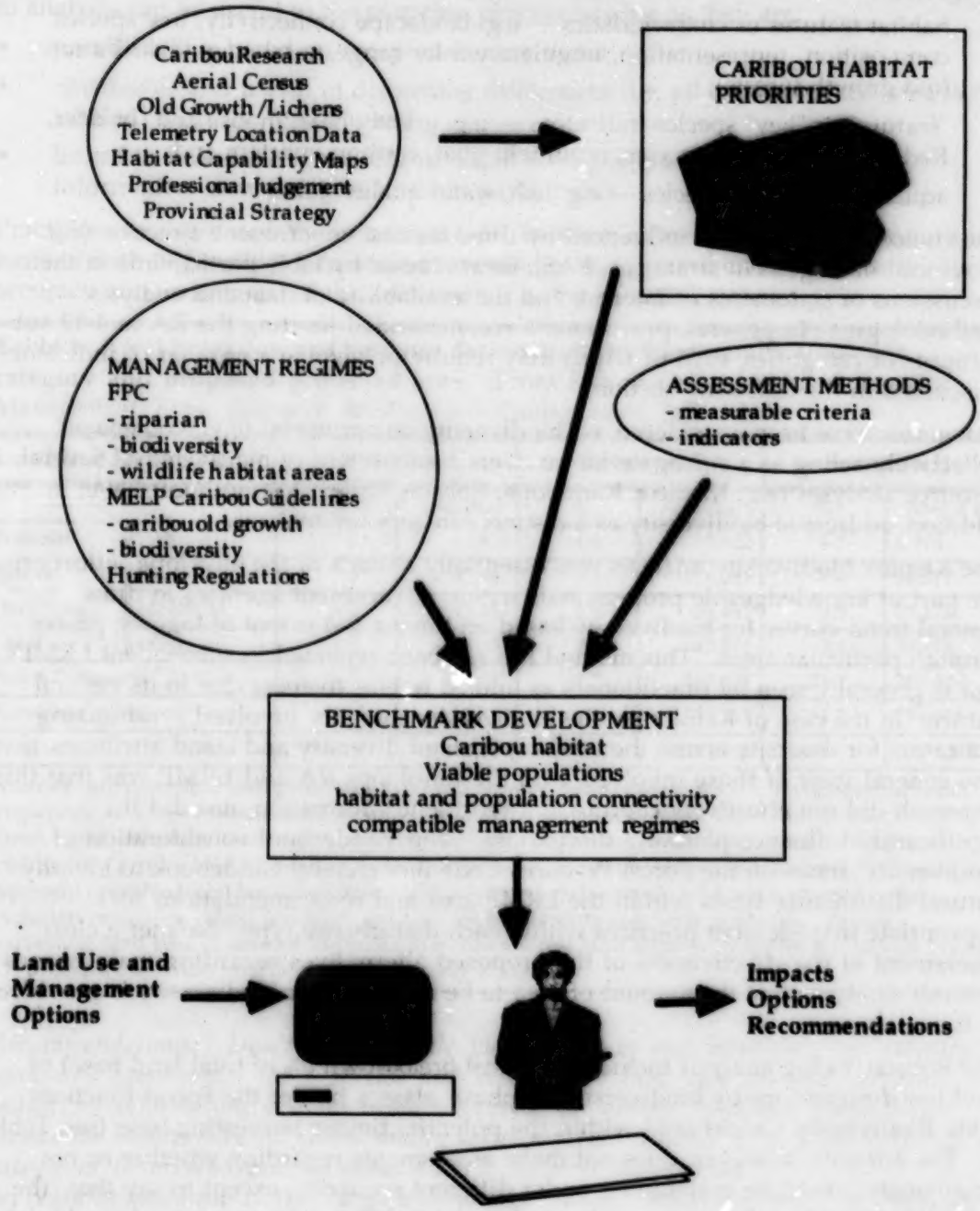
Box 4: An Example of a Resource Analysis Methodology Framework for one Analysis Category (Key Species: Grizzly Bear)

- Explain why the grizzly bear was chosen as part of the resource analysis (e.g. other species which may have similar ecological requirements and therefore face similar consequences as a result of management actions).
- Explain the habitat needs of grizzly bear.
- Discuss the land use and management influences on grizzly bear populations.
- Explain habitat capability and document where there is good/key habitat for grizzly bear (low, med., high).
- Explain habitat suitability and potential populations of grizzly bears (low, med., high) in particular areas.
- Discuss how proposed management scenarios will result in changes to grizzly habitat and the degree of impact on grizzly bear populations.
- Provide some management actions that could be taken to change the predicted trend.

Analyses also differ in terms of the number of scenarios which are developed and examined. For example, the Kamloops LRMP involved a variety of "issue scenarios" under such issue categories as protected areas, visual management, recreation/tourism, caribou management and biodiversity, which were then drawn upon in developing plan scenarios for analysis. In general, multiple levels of scenarios are complex to interpret and tend to become confusing for many participants. Developing and analysing fewer scenarios is likely to be more straightforward and understandable for participants, should result in fewer delays due to incomplete inventories or data management problems and involve lower costs for technical support teams.

Recommendations: Write a description of your analysis methodology(ies) and try to explain it to one or more of the non-technical planning participants — this will assist you in getting your thoughts in order and give you a reality check regarding what may be needed to effectively present the results of your analysis. Assembly of available inventory data may require some manipulation and summary, and/or updating — attempt to get all data available in a compatible GIS and database format.

Figure 2: An example of an explanation of methodology — "Building the caribou benchmark and application of the caribou assessment methodology, *Kootenay/Boundary Regional Biodiversity Strategy*"



4.3 Choice of analysis categories

Most resource analyses have undertaken detailed assessments under three major categories:

- habitat features or characteristics — e.g. landscape connectivity, tree species composition, representation, ungulate winter range, seral stage distribution (old growth forests);
- "feature" or "key" species indicators — e.g. grizzly bear, moose and/or deer, Red and Blue listed species, mountain goat, caribou, marten; and
- aquatic features or species — e.g. fish, water quality, lakes.

The choice of categories is influenced by three factors: government direction (e.g. provincial management strategies, PAS); issues raised by table participants in their discussions or statements of interest; and the availability of data and analysis methodologies. In general, practitioners recommended limiting the RA to 4-12 sub-accounts or categories, each of which may require or involve a number of indicators (discussed in the following section).

Categories have been considered as "biodiversity components" (e.g. Kootenays), collectively acting as a surrogate for an overall assessment of biodiversity. Several resource analyses (e.g. Kispiox, Kamloops, Robson Valley, Vanderhoof) have, in addition, addressed biodiversity as a distinct category for analysis.

The Kispiox biodiversity analysis was essentially a "back of the envelope" effort on the part of knowledgeable professionals within government agencies to draw general trend curves for biodiversity based on timing and extent of logging passes through particular areas. This method has not been repeated in subsequent LRMPs and is generally seen by practitioners as limited in effectiveness due to its general nature. In the case of Kamloops, the biodiversity category involved synthesizing indicators for diversity across the landscape, stand diversity and stand attributes. The general view of those involved with the Kamloops RA and LRMP was that this approach did not effectively capture and represent information, nor did it significantly influence planning discussions. The Vanderhoof consideration of biodiversity draws on the Forest Practices Code Biodiversity Guidebook to identify natural disturbance types within the LRMP area and recommendations for appropriate management practices within each disturbance type. Neither a clear assessment of the effectiveness of the proposed alternatives regarding maintenance of biodiversity, nor of the amount of area to be managed for biodiversity is provided in the analysis.

The Robson Valley analysis included an areal breakdown (% of total land base) of land use designations by biodiversity emphasis classes (under the Forest Practices Code Biodiversity Guidebook) within the potential timber harvesting base (see Table 3). The analysis, however, does not make assessments regarding whether or not biodiversity would be maintained under different scenarios, except to say that "the risk of maintaining all native species and ecological processes increases from high to low biodiversity emphasis options." This analysis category may become more common if more LRMP processes include biodiversity emphasis categories as part of their scenarios of management objectives and strategies.

Habitat categories are heavily used in RA because they involve mappable information (e.g. habitat capability maps, forest cover maps) and provide the basis for subsequent analysis and discussion regarding size and diversity of species populations and broader ecosystem resilience. In general, habitat-based approaches to analysis can be useful to the planning process so long as they are:

- justifiable (i.e. based on accepted assumptions);
- reasonable and useful in discerning differences (i.e. all or most of the area is not labeled "high" or "good"); and
- linked to broader assessments of impacts on populations so that the information is meaningful to table participants.

Practitioners also noted the importance of "truthing" map based information on the basis of both (if possible) local expert knowledge and ground checks to ensure accuracy and acceptance of the information in the planning process.

Table 3: Areal breakdown of land use designations by biodiversity emphasis category and proposed protected area. (From *Robson Valley Land and Resource Management Plan: Resource Analysis — Environment*, Jan. 1996)

Land Use Designation		Base Case		Scenario I		Scenario II	
		%	Area (ha)	%	Area (ha)	%	Area (ha)
Potential	PAS	1.2	14,950	1.4	17,822	0.7	8,925
Timber	HIGH	7.0	85,963	9.3	114,287	7.4	90,577
Harvesting	MEDIUM	4.2	52,107	2.9	35,491	5.9	73,176
Landbase	LOW	4.7	58,151	3.5	43,571	3.1	73,176
Forest Exclusions		21.7	267,627	21.7	267,627	21.7	267,627
Non-forest exclusions		61.1	753,311	61.1	753,311	61.1	753,311
Total		**100**	**1,232,505**	**100**	**1,232,505**	**100**	**1,232,505**

Numbers are percent of total planning area (1,232,505 ha). Forest exclusions = non-commercial brush, inoperable areas, environmentally sensitive areas (ESAs), problem forest types, low productivity forest types, immature forest types, riparian, caribou "high" and preservation areas. Non-forest exclusions = private land, non-forest types, and roads. PAS = proposed protected areas. PAS hectares represent operable forest land. Any forest and non-forest exclusions in a PA are contained in the exclusion categories. High, Medium, and Low are biodiversity emphasis categories. Timber harvesting land base is defined as productive crown forest land initially available for harvest. Note: 1% difference over the total land base is roughly 12,000 ha.

Recommendations: Don't try to tackle biodiversity in one mouthful!! — identify some key components (both species and ecosystems) that may provide surrogate or indicative information and, if feasible, provide an overall synthesis of predicted trends for biodiversity in verbal and/or written form. Choose 4 to 8 sub-accounts or categories to present your information [e.g. general biodiversity — representation/connectivity; ungulate winter range: moose/caribou/deer (species will vary from area to area); fisheries — significant stream reaches, riparian ecosystems, peak flows, lakes (access and shoreline); domestic watersheds — water quality, Equivalent Clearcut Area]

4.4 Choice of analysis indicators

Indicators are the measurable criteria employed to evaluate each of the categories chosen for analysis. The selection of appropriate indicators for analysis can be both complex and contentious. Some of the factors that influence the choice of indicators include:

- identified limiting factors based on habitat modeling for a chosen category (e.g. winter range for ungulates, water quality or road density for fish);
- availability of inventory information;
- availability of analysis methodologies (i.e. measurable indicators or criteria);
- ease of presentation and understanding by planning participants;
- priorities of agency staff, reflecting technical or human resources constraints; and
- expressed priorities of planning table participants.

An extensive discussion of indicators for resource analysis is the subject of the March 1995 report *Environmental Indicators for Land and Resource Management Planning*, prepared for the Ministry of Environment, Lands and Parks.

During the course of this review, practitioners also suggested using the same set of indicators or assessment criteria wherever possible across the various accounts (or categories) of resources being analysed (see Box 5). In terms of the LRMP process, such assessment criteria can be considered to be indicators (see also the discussion of terminology in section 2.6).

Box 5: Assessment Criteria used in the Bulkley Resource Analysis for the entire "Feature Species Set of Accounts" (grizzly bear and wolverine, woodland caribou, mountain goat, moose and deer)

- Human Access Management
- Habitat Alteration
- Habitat Fragmentation
- High Value Habitat Management
- Predation Pattern Alteration

Recommendation: When identifying appropriate indicators for analysis, consider issues, relevant categories, inventory availability and existence of acceptable models for linking indicators to relevant values/resources.

4.5 Using inventory information, proposed management regimes and indicators to predict impacts

Having selected a set of analysis categories and appropriate indicators for each of the environmental resources, the next step is to evaluate the potential impacts of proposed management regimes under defined scenarios to each of the analysis indicators. This is the heart of the analysis. The process involves an integration of various management regimes overlaid with varying capability/suitability levels of habitat for the environmental resource under analysis. The outcome should be a

value or rating presenting the user with a clear indication of the likelihood of sustaining that resource under a given scenario, or the risk of the resource becoming unsustainable under that scenario. The scenarios can be compared against each other and/or a defined benchmark (see discussion in subsequent sections).

The analysis process requires three types of information:

1. Environmental resource inventory data:
   - total area of habitat presently or potentially utilized by the environmental resource under analysis;
   - location and distribution of habitat presently or potentially utilized by the environmental resource under analysis; and
   - relative rankings or ratings of habitat on the basis of habitat capability and/or suitability (e.g. high (10), medium (6), low (3), not used (0));
2. Scenario descriptions — consisting of essentially two types of variables:
   - those describing management regimes — general management zones (e.g. protected, special management, integrated, enhanced development and private); and individual management polygons with specific combinations of guideline sets (e.g. high-medium-low emphasis biodiversity with or without access controls, visual constraints, community watershed guidelines); and
   - the geographic distribution of management regimes — total area of each of the management regimes; and location and distribution of the management regimes within the planning area; and
3. Impact evaluation of each management regime with respect to indicators for the environmental resource under analysis:
   - relative rankings or ratings of management regimes with respect to their effects on the relevant indicators (e.g. if an indicator for caribou is old growth retention, relative ratings of management regimes might be — protected (10), caribou guidelines (8), high emphasis biodiversity (6), medium emphasis (4), low emphasis (1), private land (0)).

The actual analysis and generation of potential impacts for the scenario as a whole requires an integration of the above listed information. This can be completed by overlaying a management regime map (or series of maps) with the capability/suitability maps and summarizing the percentages of high, medium and low capability habitat with the various compatibility levels of management regimes. Analysis of the overlays can be completely qualitative, with a visual examination of the results, quantitative with area summaries produced by manual of GIS measurements of areas (see Table 4), or semi-quantitative with a combination of area summaries and qualitative assessments.

Table 4. An example of an area summary resulting form an overlay of habitat capability with a group of management regimes.

(BEC - Biogeoclimatic unit, PA - Protected Area, HEB, MEB, LEB - High, medium, low emphasis biodiversity, Priv - private, TOT - Total.)

	Total Area by Capability (ha)			High Capability by Mgmt Regime (ha)					Medium Capability by Mgmt Regime (ha)			
BEC	High	Med	Low	PA	HEB	MEB	LEB	Priv	PA	HEB	MEB	LEB
TOT	209168	149149	144280	61103	33854	51510	28114	34587	27714	15689	59353	
ICH	70345	59647	13458	1645	4658	4563	24892	34587	3876	5698	26541	etc.
ESSF	77135	22146	35498	23567	5648	45372	2548	0	9854	5624	4356	
AT	61688	67356	95324	35891	23548	1575	674	0	13984	4367	28456	
etc.	etc.			etc.					etc.			

A potential second step in a quantitative analysis is assigning weighting factors to the range of habitat capability/suitability levels and management regimes. Percentages of the total habitat areas falling within each capability/management regime combination can be multiplied by the weighting factors and summed to produce an overall assessment for the planning area/ management regime combination as a whole. Table 5 provides an example of weighting factors used in the Kootenay/Boundary impact analysis. The bar graphs rating the habitat-related risk of various scenarios against a defined "low risk" benchmark shown in Figure 5 (section 4.7) were derived by such a process. Alternatively, specific habitat units or map polygons can be ranked by overall importance to an environmental resource, and analysis results weighted according to that ranking. The bar graphs presented in Figure 3 (section 4.6) are sums of rating factors applied to a qualitative assessment of individual indicators for the planning area as a whole. Although both of these processes provide a quantitative value, the processes are semi-quantitative because the weighting factors are based on professional judgment or expert opinion.

Table 5. Examples of weighting factors for compilation of results from the Kootenay/Boundary impact analysis.

	Caribou Habitat Priority			Grizzly Management Priority				
Management Regime	H	M	L	VH	H	M	L	VL
Protected	2.00	1.50	1.00	5.00	4.00	3.00	2.00	1.00
MELP Biod. Guidelines	1.70	1.28	0.85	3.60	2.88	2.16	1.44	0.72
MELP Caribou Guidelines	1.80	1.35	0.90	3.60	2.88	2.16	1.44	0.72
High Emphasis Biod	1.60	1.20	0.80	3.00	2.40	1.80	1.20	0.60
Med Emphasis Biod	0.80	0.60	0.40	1.50	1.20	0.90	0.60	0.30
Low Emphasis Biod	-0.50	-0.38	-0.25	0.75	0.60	0.45	0.30	0.15
Private	-1.00	-0.75	-0.50	0.00	0.00	0.00	0.00	0.00

It has to kept in mind that thresholds may operate in some cases and tradeoffs between types of management may vary with the areas, management regimes and indicators involved — huge areas of minimal management or extremely small areas of excellent management may not be equivalent to large areas of moderately acceptable management (nor, for example, sufficient to maintain viable populations of a particular species).

In addition to summing total amounts or percentages of habitat with specific management regimes, it may be necessary to qualitatively examine considerations such as:

- patch sizes of habitat with favourable management;
- distribution or specific location of the habitat with favourable management; and
- potential spatial relationships between habitat with favourable management (i.e. connectivity or habitat linkages).

Another issue that should be addressed in the analysis is the particular combinations of habitat that may be required by a species or group of species. If a species requires habitat at high and low elevation at different seasons, the distribution of low risk management regimes may be critical (e.g. caribou may require high elevation (ESSF) old growth for late winter habitat and mid-low elevation old growth (ICH) for early winter habitat). When designing and evaluating area summaries (as in the example in Table 4), it is critical to separate results in such a way to recognize such factors (e.g. compare results of TOTAL vs. ICH, ESSF and AT in high capability habitat). In this case, the total would indicate moderate to low risk management overall, however there is very limited favourable management in the ICH, and the risk is probably much higher for a species that depends on habitat at high and low elevations.

Various options should be considered as summary spatial units for each category or environmental resource assessed. Using subdivisions of the total planning area provides better resolution for presentation of the results and may assist in providing direction for mitigation of impacts or improving on future scenarios or options. Summarizing results in more than one manner may also be warranted. Possible summary units include:

- natural units — ecosections, biogeoclimatic units, watersheds or bio-regions;
- distinct populations or herds; and/or
- administrative units — districts, TFL/TSA, planning cells, landscape units.

Recommendations: Keep the following questions in mind when undertaking your analysis — Does the analysis adequately represent the management option proposed, including realistic assumptions regarding implementation? Does the analysis address all the key requirements for maintaining the environmental resource at a sustainable level, and if not, are these clearly stated in the assumptions and limitations? Do the analysis results clearly portray the risks to the environmental resource of proceeding with each of the scenarios examined?

4.8 Establishment of benchmarks for comparison

Clear reference points ensure that the true significance of any impacts can be fully appreciated in the analysis. The reference point against which scenarios are being compared must be explicit and meaningful in terms of sustainability of the environmental indicator or factor under consideration. Some analyses compare scenarios against historical or natural conditions; others provide comparisons against a limited base case that considers only current conditions. It is strongly recommended that scenarios are compared against a base case which incorporates past trends and current practices to make predictions of likely future conditions. Establishing a base case for the analysis which clearly sets out the anticipated future conditions resulting from present management practices provides planning participants with a foundation for discussing and comparing potential management alternatives.

As well as providing a such a projected future base case, some resource analyses also compare scenarios against a desired environmental condition, or a benchmark defined by a set of preferred management guidelines and conservation biology practices. The use of environmental benchmarks as a basis for comparison in the resource analysis is growing in acceptance and provides planning participants with a clear assessment of the consequences of proposed management scenarios (See Box 6). If benchmarks are used, the standard or level should be clearly explained. Participants also need to be able to understand the linkages and assumptions made in deriving the benchmarks (e.g. ha. of suitable late seral stage habitat presumed to be present for woodland caribou winter range is important for the long-run viability of woodland caribou populations because winter range has been identified in research studies and field observation as the key limiting habitat variable for caribou).

The use of environmental benchmarks may be challenged on the basis that they are intended to unduly sway planning discussions towards the achievement of a particular environmental standard or objective. This criticism can be addressed by providing environmental benchmarks only as a means of identifying the consequences of differing sets of management actions on environmental indicators, not as a judgment of whether or not any particular set of actions is "appropriate" or "acceptable." Benchmarks for other resources, although not explicitly labeled as such, are currently embedded in the current LRMP planning process. For example, the TSR sets a benchmark for the production of timber through establishing a Long Run Sustained Yield (LRSY) level and the subsequent setting of an AAC. If environmental benchmarks are not used as part of the resource analysis, key biophysical consequences of planned activities may be under-rated or overlooked.

Recommendation: Establishing environmental benchmarks for comparison of alternative scenarios is a key element of resource analysis — draw on existing management goals and strategies for components of the environmental accounts wherever possible and frame in the context of a risk assessment (see section below) if appropriate.

Box 6: Examples of Benchmarks Used in Resource Analysis

1. Kootenay/Boundary Regional Biodiversity Strategy: Benchmarks

The Regional Biodiversity Strategy developed for the Kootenay/Boundary region, identified five representative *biodiversity components* for detailed assessment (regionally significant fisheries, woodland caribou, ungulate winter range, representative ecosystems/regional connectivity and grizzly bears). *Benchmarks* were then developed for each component to provide a standard against which to assess land use plan scenarios based on management strategies deemed capable of maintaining functioning ecosystems and viable species populations. In general, each benchmark consists of:

- *spatially defined areas of interest* (i.e. maps);
- *management regimes* defined in terms of MELP Habitat Guidelines developed from the work of regional (CORE) planning processes; and
- selected *guideline applications* from the Forest Practices Code and companion guidebooks.

The benchmarks are developed to provide a point of reference for each biodiversity component, from which the potential cost or benefits of alternative management options can be measured. Their purpose is to enable governments and policy-makers to consider the impacts to biodiversity of various land use or management decisions, as well as measure progress in restoring damaged ecosystems (see also Figures 2 above and 3 below for descriptions of the methodology for developing specific benchmarks).

2. Bulkley Resource Analysis: BC Environment's Acceptable Level

In this resource analysis, the **Feature Species Environmental Accounts** (grizzly bear and wolverine, woodland caribou, mountain goat, moose and deer) analysis was based on a minimum level of management needed to achieve sustainability for the species' habitat type in order to maintain at least the minimum population level desired by BC Environment for the species in question. The "optimizing habitat conditions for the given species" was then estimated and set to an arbitrary level of 100 for a comparative analysis of various alternatives. "BC Environment's Acceptable Level" was then established relative to this optimum (ranging from 60 to 95 on the comparative scale) and each alternative land use scenario assessed according to the same scale.

Figure 3: An example of comparison of alternative scenarios utilizing "BC Environment's Acceptable Level" (Adapted from *Analysis of the Community Resource Board's Land Resource Management Plan Options for the Bulkley Timber Supply Area*)

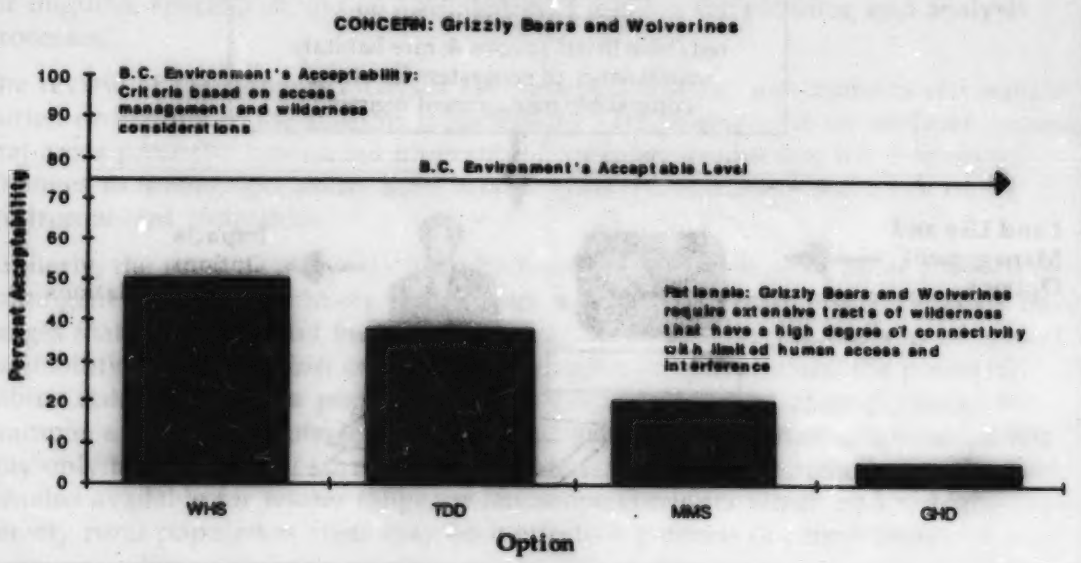
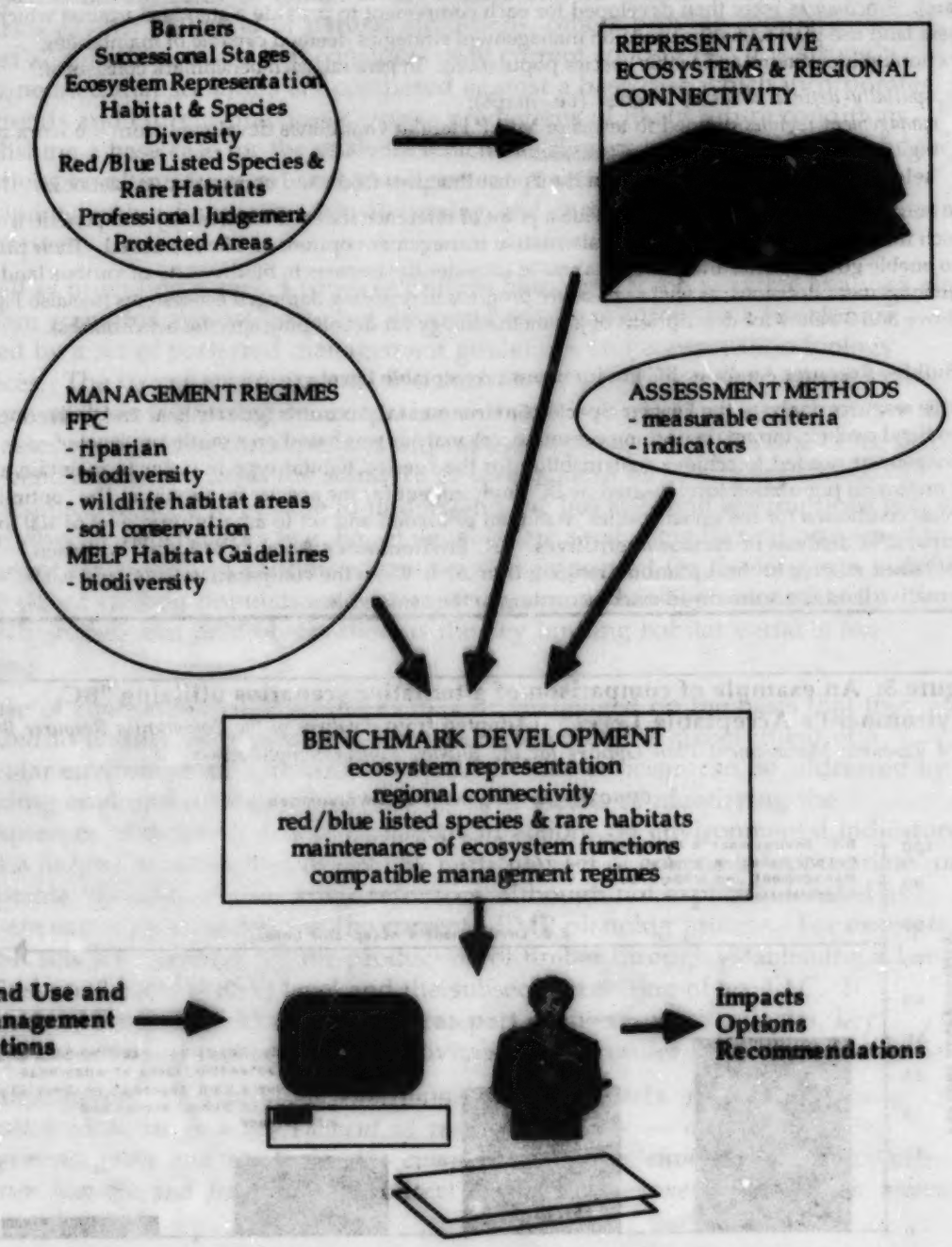


Figure 4: An example of the methodology used to develop environmental benchmarks "Building the representative ecosystems/regional connectivity benchmark and application of the assessment methodology, *Kootenay/Boundary Regional Biodiversity Strategy*" (See also Figure 2 in section 4.2 of this report)



4.7 Choice of approaches to address uncertainty in analysis, assess risk and set the analysis in context

The current state of knowledge of functional linkages between components of ecological systems, and by extension, between indicators and the variables included in the analysis, will determine the level of sophistication and accuracy of the analysis. The underlying model of these linkages should be made explicit to avoid misinterpretation of analysis results by non-technical participants. To ensure that planing participants appreciate the limitations of the analysis, problems in interpretation or extrapolation, data gaps, subjectivity of information and other difficulties should be made explicit in analyses. These statement should be not be used simply as disclaimers undermining the information presented, rather they provide the foundation for making reasonable statements and assessments within the limitations of the analysis methodology.

Assumptions made as part of the analysis should be explicit. For example, some analyses assume that requirements for a given species may be met through other planning provisions at the landscape or operational scale (e.g. Forest Practices Code). Some of the assumptions made may include:

- uncertainty and precision of data base (accuracy versus precision);
- the scale of the planning process and the associated analysis — regional to sub-regional, and the level of generalization of available information; and/or
- models or empirical/theoretical relationships and the algorithms used to project and predict future conditions.

Wherever possible, these analysis assumptions should be discussed at the table and agreement reached prior to the discussion of results to simplify interpretation. It is often easier to get agreement on the general principles used in the analysis in this way, rather than waiting until actual analysis results are reviewed. The key limiting factors that drive the resource analysis for each species or indicator (e.g. winter range for ungulate species) should be also identified early in the planning and analysis processes.

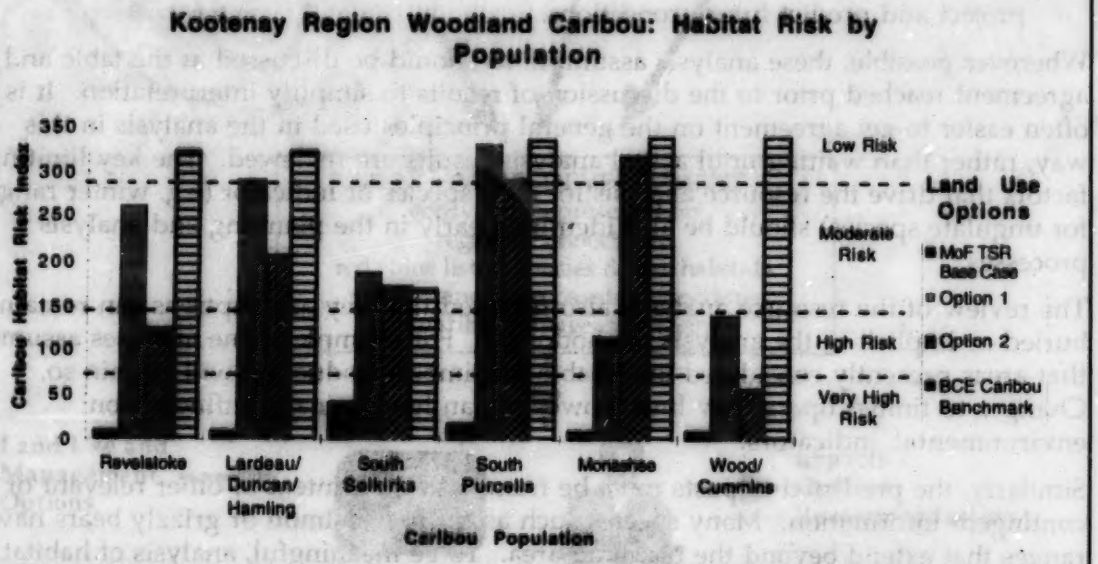
The review of the resource analyses also revealed that key assumptions can remain buried or implicit in the analysis methodology. For example, some analyses assume that areas presently considered inoperable for timber production will remain so. Changes to timber operability lines however, can have a major influence on environmental indicators.

Similarly, the predicted impacts must be framed in the context of other relevant or contingent information. Many species such as caribou, salmon or grizzly bears have ranges that extend beyond the planning area. To be meaningful, analysis of habitat availability within the plan area must consider, or at least discuss, the potential habitat risks to particular populations which exist outside the planning area. For example, a small area outside of Crown land managed for critical ungulate habitat may only be accessible if surrounding private land, which is not subject to the plan, remains available for winter range, or landscape corridors which end in high density rural population areas may be ineffective in terms of connectivity.

Levels of confidence in analysis results, the extent of potential effects of proposed management scenarios on environmental indicators and the consequences of those effects must be made explicit in analyses to ensure that planning table participants understand the scope of the trade-offs that they face. While formal risk assessments may not be feasible, planning participants should be made aware of the likely scope and consequences of proposed scenarios and be aware of MELP strategic direction regarding the objective review of plans and proposals (see Box 1). Framing analysis around the concept of risk provides a good context for consideration of the analysis results.

A risk assessment approach to developing and presenting analysis results has been most explicitly adopted in the Kootenay/Boundary Regional Biodiversity Strategy. For example, habitat risk to woodland caribou for a variety of scenarios was assessed using a "caribou habitat risk index" and presented by caribou population in a bar graph format categorized from very high to low risk (see Figure 5). This approach gives a very clear picture of the relative consequences of various options — utilizing a format that is understandable to a lay audience, yet also including a methodology that is able to be replicated and refined by other technical staff.

Figure 5: An example of analysis based upon an assessment of risk "Kootenay Region Woodland Caribou: Habitat Risk by Population, *Kootenay/Boundary Regional Biodiversity Strategy*"

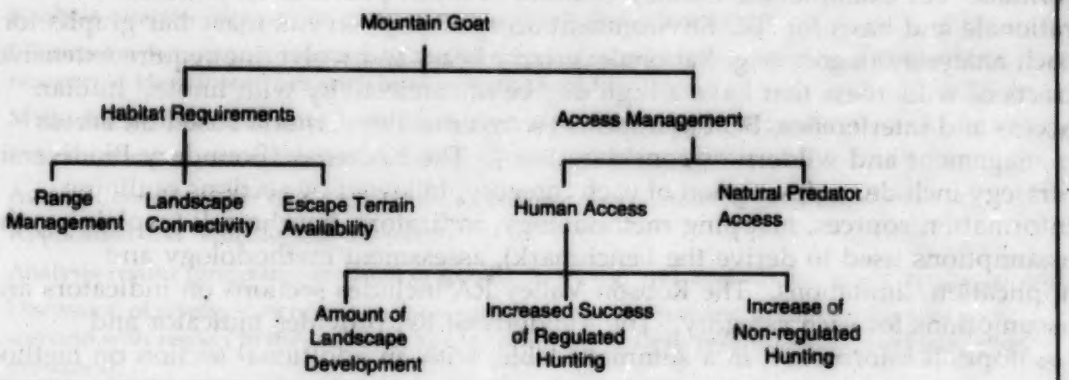


Recommendation: ***Framing your analysis using a spectrum of very high to low risk enables the presentation of complex results in a clearly understandable and effective form — try it!***

4.8 Completion of the analysis and assessment of the analysis results

If the scenarios provided for analysis clearly state intended outcomes and the management strategies designed to achieve them, then the task of resource analysis is less dependent on assumptions and inference on the part of the technical analysts. For example, in the case of the Bulkley RA, the level of detail provided by the Community Resource Board regarding options for forest connectivity corridors and projected access to lakes in the district enabled a more objective and complete modeling and assessment. Hence, effort must be made early in the planning process to lay the groundwork for the resource analysis among planning participants. This groundwork should involve discussion with participants regarding the level of detail needed for effective analysis and the indicators by which the alternative scenarios will be assessed (e.g. human access management, habitat alteration, habitat fragmentation, high value habitat management and predation pattern alteration). Discussion of key or limiting analysis indicators, and the linkages between factors involved in the analysis, will also increase the understanding and acceptance of the analysis results by participants (see Figure 6).

Figure 6: An example of identification of key analysis indicators and linkages for Mountain Goat (Adapted from *Analysis of the Community Resource Board's Land Resource Management Plan Options for the Bulkley Timber Supply Area*)



The analysis methodology utilized in the Kootenay/Boundary Regional Biodiversity Strategy further enables a ranking of all habitat polygons in order of importance for the identified environmental indicators (e.g. the 1-20 top ranked ungulate winter range habitat polygons in the region). Overlays of rankings for different indicators can then easily be undertaken to identify specific areas which have a high ranking for several indicators (which could then be called "high value biodiversity areas"). It is very important for such ranking systems to be built upon clear and defensible criteria. This type of information is extremely valuable in land use planning discussions, however, data, technology and resource limitations may preclude or limit use of the methodology in some areas.

Recommendations: Assessment of analysis results builds on the foundation laid early in the planning and analysis processes — a clear methodology, understood and accepted by key audiences, increases the effectiveness of the resource analysis. Work with planning participants to ensure that scenarios provided for analysis are in a form that supports meaningful analysis results.

4.9 Presentation of analysis results

Clear presentation of analysis results is of critical importance to the effectiveness of the resource analysis. Part of the role of RA in land use planning is to educate participants regarding the issues involved in the planning task and the pros and cons of alternative actions. At the very least, the analysis should identify the trend for each indicator that results from actions proposed under alternative scenarios and the major factors influencing the trend lines. The analysis results need to be set in context, i.e.:

- this is what will happen (within the analysis assumptions and information provided);
- this is why the analysis predicts that it will happen; and
- this is what could be done about it (based on knowledge of specific areas and/or examples from other related situations).

Resource analyses to date have presented information concerning the analysis categories, methodologies and assumptions involved in the analysis in a variety of formats. For example, the Bulkley resource analysis provides an additional rationale and basis for "BC Environment acceptability" on summary bar graphs for each analysis category (e.g. Rationale: grizzly bears and wolverine require extensive tracts of wilderness that have a high degree of connectivity with limited human access and interference; BC Environment's Acceptability: criteria based on access management and wilderness considerations). The Kootenay/Boundary Biodiversity Strategy includes a description of each category, followed by sections outlining information sources, mapping methodology, indicators, benchmark (explaining the assumptions used to derive the benchmark), assessment methodology and application/limitations. The Robson Valley RA includes sections on indicators and assumptions for each category. The Vanderhoof RA provides indicator and assumption information in a summary table, with an additional section on method.

The Kispiox Fish and Wildlife Analysis provided a clear outline of suggested "mitigation measures to lessen the impact on fish and wildlife resources" in a separate section of the analysis report. A slightly different approach was used in the more recent Bulkley resource analysis, involving a "descriptive analysis summary" of the positive and negative aspects of each scenario which includes intended or possible mitigation and management strategies. Planning participants may also benefit from examples from other areas or cases where similar impacts have been observed or where mitigation strategies have been attempted (e.g. time series photos, case studies).

A variety of methods have also been used to present resource analyses results. The Robson Valley and Vanderhoof resource analyses provide summary tables of some analysis categories with a short narrative either stating the trend (e.g. Robson Valley Red and Blue listed species — stable population in the short term, potential for decline in the long term; potential for decline reduced; same trend as base case) or an assessment of risk to populations (e.g. Vanderhoof Red and Blue listed species — unknown; high risk; moderate risk; reduced risk). The Kispiox fish and wildlife analysis provided a general curve over time for the identified indicators. The Bulkley and Kootenay/Boundary reports presented analysis information in the form of bar graphs representing a cumulative assessment of the consequences of each scenario over time.

Comments from practitioners suggest that presenting resource analysis results in the form of bar graphs with a comparison of relative effects of alternate scenarios is most effective (see earlier Figures 2-4 for examples of Bulkley and Kootenay/Boundary analysis results). This type of presentation goes beyond broad comparison statements such as "high, medium, low" or "slightly more, slightly less" and involves tying the analysis to clear assessment criteria and a replicable methodology. This presentation format will thus necessitate careful attention to the methodology utilized in structuring the resource analysis.

Box 7: Suggested Format for Presentation of Results

For each analysis category considered, the following information should be presented in summary form:

- Analysis category (description of category and why it was selected);
- Information sources (e.g. biophysical habitat mapping, aerial census data, population models, research studies, interviews with local experts, mortality data);
- Methodology used for the analysis (e.g. habitat capability mapping, modeling);
- Indicators (description of indicators and why they were selected);
- Assumptions (that were used to assess the consequences of alternative scenarios);
- Application and limitations of the results;
- Analysis results (preferably in visual or graphic form, e.g. area analysis, bar graph synthesis); and
- Discussion of results (descriptive analysis summary, e.g. positive and negative aspects of each scenario with respect to the indicator, key factors in the analysis results or suggested mitigation measures).

Recommendations: No matter how good your analysis is — if few people understand it, then it won't be used. Dedicate time and solicit support for developing the presentation format and content for the resource analysis and test drafts or sections among different audiences. The presentation of the resource analysis should "tell a story" about what is or might be happening in the planning area as a result of the proposed management actions — as well as "presenting the facts." Include a mix of graphics and written material, with large data tables generally relegated to appendices. Text is necessary for those who do not easily comprehend graphs and tables. Graphics (graphs, figures and generalized maps) are essential.

4.10 Application of the analysis results in the planning process

In some cases, the resource analysis has only been available late in the planning process. Delays have been encountered in completing essential inventories, ensuring the compatibility of data sets, resolving translation errors and establishing a workable GIS — impeding the planning process and/or delaying the resource analysis to an "after the fact" point of inconsequence. As a result, the RA has been used less as an analytical tool during negotiations and more as a summary tool to check on the balance of the outcome of discussions and build buy-in among participants on consensus recommendations. This approach may limit or delay contentious discussions and complex analyses but it involves significant drawbacks:

- negotiations may be poorly informed and may develop an agreement which proves to have significant or unacceptable consequences for a range of environmental values or resources; and
- the effort involved in re-opening, reviewing and re-negotiating preliminary consensus agreements could be considerable, requiring difficult and politically complex "about turns" by planning participants, and significant technical analysis time and resources.

Practitioners identified fisheries and water resources as particularly weak areas in the resource analyses undertaken to date. The Bulkley resource analysis provides one example of a more detailed methodology and approach for assessing "inaccessible lake fish stock conservation." The approach involves utilizing projected ROS lake classification (primitive and semi-primitive) to estimate impacts of increased access on fish stocks, with the assumption that "maintenance of trout and char lake populations, age classes and genetics is largely dependent on retention of inaccessible lakes" (see Figure 7). To further consideration of water-related indicators in resource analysis, a table of suggested categories and indicators, with accompanying analysis procedures, is also provided (Table 6).

Figure 7: Inaccessible Lake Fish Stock Conservation table and summary
Adapted from *Analysis of the Community Resource Board's Land Resource Management Plan Options for the Bulkley Timber Supply Area*

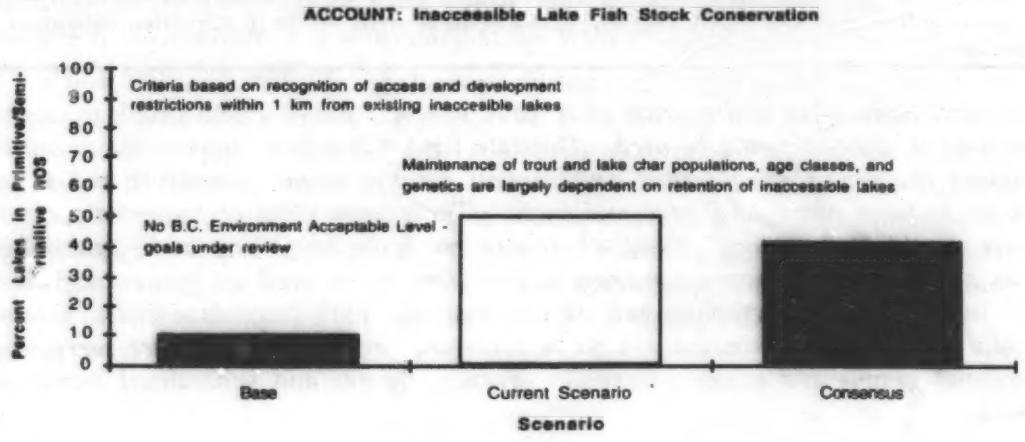


Table 6: Suggested resource analysis procedures for water-related issues				
Category	**Indicators and Inventory Requirements**	**Analysis Procedure**	**Scenario Information**	**Assumptions**
Stream and River Fisheries (by key species)	Riparian protection, peak flow index, ECA, road density, channel stability, access Locations and ranking of high value fisheries stream reaches and watersheds (criteria could include spawning/rearing habitat, spp. diversity, red/blue spp.) Landslide and surface erosion hazards and/or sediment yield potential	GIS overlays of relevant steam reaches and watersheds with defined management regimes	Guidelines related to riparian protection, road crossings, sediment control, development on high surface erosion and landslide terrain Projections of road development, ECA, access Water demand for other uses	Water quality, peak flow, access and riparian mgmt. are the key indicators for stream fisheries; road density and sediment yield potential are indicators for water quality, ECA and road density are indicators of peak flow modification
Lake and Pond Fisheries	Shoreline protection, flow regimes, access, water quality, sediment yield potential of inflow streams Locations and ranking of high value fisheries lakes and ponds and their watersheds (spp diversity and habitat)	GIS overlays of relevant lakes and ponds, their watersheds and with defined management regimes	Projections of access development, ECA, shoreline protection Guidelines related to sediment control on inflow streams	Shoreline modification, sediment yield potential of inflow streams are key indicators for water quality Access is a key factor in fishing pressure
Domestic/ Irrigation Watersheds	Riparian protection, peak flow index, ECA, road density, sediment yield potential, access Water demand, intake locations and design, water treatment	GIS overlays of relevant steam reaches and watersheds with defined management regimes	Guidelines related to riparian protection, road crossings, sediment control, development on high surface erosion and landslide terrain Projections of road development, ECA, access	Water quality peak flow, access and riparian mgmt. are the key indicators for domestic watersheds; road density and sediment yield potential are indicators for water quality; ECA and road density are indicators of peak/low flow modification

Recommendation: Needless to say, all effort should be made to have the requisite pieces of resource analysis in place at appropriate steps in the planning process to ensure full use of the analysis information and results. Keep in mind that resource analysis is iterative and can/should be revisited as more information becomes available.

4.11 Use of the analysis in plan implementation and monitoring

At a minimum, resource analysis results should provide a baseline for future monitoring of:

- the actual achievement of intended management objectives (i.e. did we do what we said we would do?); and
- whether the plan succeeded in protecting biophysical values as predicted (i.e. did we do the right thing?).

The experience of conducting a resource analysis may have other spin-off benefits for technical staff in terms of clarifying analytical methods and providing tools for application to other resource management tasks. However, given the time and effort expended on this exercise, resource analysis should also be designed to provide a basis for more active management and planning in the short and medium term. This may require additional inventories, the refinement of indicators to match changing conditions and/or additional analyses based on methodologies developed during the planning process.

Recommendation: Consider producing two distinct resource analysis reports (or at least a technical addendum), one report which addresses the specific needs of planning participants and one report/database (in written and electronic form) geared to technical staff or others who may be responsible for implementation and monitoring the plan.

4.12 Time and cost considerations

If a resource analysis is not available to planning participants at appropriate times in the planning process, its use and effectiveness is greatly diminished. Delays or gaps in the resource analysis have been a major weakness in many of the planning processes to date. With appropriate inventory information and adequate analysis support tools (e.g. GIS), practitioners suggested that an effective impact assessment could be completed within six to fifteen days of knowledgeable staff time. However, it is very difficult to undertake an analysis "off the corner of your desk" — the analyst(s) need to be assigned solid blocks of time, separate from day to day assignments, in order to effectively complete the resource analysis. Practitioners also recommended involving a range of MELP and other agency staff in preparing and "peer reviewing" an analysis in order to improve the accuracy of, and broaden the support for, the resource analysis.

In several of the cases under review, MELP staff relied heavily on contracted assistance to undertake the resource analysis. The use of contractors can allow staff to play a more involved role in planning table discussions, without compromising independence and can reduce the time burden on staff with onerous work assignments. However, contractors need to work very closely and under the direction of technically knowledgeable MELP staff to be effective.

Recommendations: Evaluate the time and scenario information required for the chosen resource analysis methodology to ensure that the analysis can be reliably performed within the timelines required by the planning process. Work with planning participants to ensure that the planning process respects the timelines required to perform the analysis and that scenario development includes all relevant information required to run the analysis. Test and develop methodology using historical, base case or environmental benchmark scenarios prior to having to respond to scenarios developed by planning participants.

APPENDICES

A. Interview respondents and template

The following individuals were interviewed by telephone during the course of this project:

- Bill Arthur, MELP Habitat Technician, Omineca Peace Region, Prince George — Vanderhoof LRMP;
- Pat Field, MELP Planning and Assessment Manager, Kootenay Regional HQ, Nelson — Kootenay/Boundary Regional Biodiversity Strategy;
- Bruce Jamieson, MELP Water Allocation Section, Omineca Region, Prince George — Robson Valley LRMP;
- Dave King, MELP Regional Habitat Biologist, Omineca-Peace Region, Prince George (contact information only);
- Sandy MacDonald, MELP Habitat Section Head, Southern Interior Regional HQ, Kamloops — Kamloops LRMP;
- Jim Pojar, MOF Forest Ecologist, Prince Rupert Region, Smithers — Kispiox Biodiversity Analysis;
- Chris Ritchie, MELP Integrated Management Biologist, Omineca Peace Region — Robson Valley LRMP;
- Elliot Terry, Keystone Consulting — Robson Valley and Peace Region LRMP Resource Analysis Consultant;
- Len Vanderstar, MELP Acting Senior Habitat Protection Biologist, Skeena Region, Smithers — Bulkley LRMP; and
- Gord Wolfe, MELP Habitat Biologist, Skeena Region, Smithers — Kispiox Fish and Wildlife Analyses.

The interviews were openly structured, using a standard template that was faxed to each respondent in advance with provision for detailed discussion and comments as raised during each interview.

Interview Template

Sequence of Steps in Resource Analysis	Interview Questions	Rating of Effectiveness (Use and/or acceptance in the planning process)
1. Identification of issues for analysis	• What key issues were identified prior to the analysis? • How were these issues identified and by who?	How would you rate participants' acceptance of these issues? ❑ Good ❑ Fair ❑ Poor

2. Description of analysis methodology	• What methodology was utilized in the resource analysis (e.g. expert opinion, overlays, GIS)? • How was qualitative and quantitative information incorporated in the methodology? • How was the methodology selected and by whom?	How would you rate participants' acceptance of the choice of methodology? ❑ Good ❑ Fair ❑ Poor
3. Choice of analysis categories	• What categories were used to classify and direct the resource analysis? • How and why were they chosen? • Does the existing "Indicators Report" capture the approach you used adequately?	How would you rate participants' acceptance of the choice of categories? ❑ Good ❑ Fair ❑ Poor Were all categories useful?
4. Choice of analysis indicators	• What indicators were used in the analysis? • How and why were they chosen? • Does the existing "Indicators Report" capture the approach you used adequately?	How would you rate participants' acceptance of the choice of indicators? ❑ Good ❑ Fair ❑ Poor Were all indicators useful?
5. Establishment of benchmarks for comparison	• What are the baselines or benchmarks against which options or alternatives are compared (e.g. status quo, Base Case including current trends, environmental benchmarks)? • How were the benchmarks established?	How would you rate participants' acceptance of the choice of benchmarks? ❑ Good ❑ Fair ❑ Poor
6. Choice of approaches to address uncertainty in analysis, assess risk, and set the analysis in context	• How are questions of risk (long term viability) addressed within the resource analysis? • How are questions of uncertainty addressed within the resource analysis? • Does the resource analysis consider and were the results explained in the broader environmental context in which the plan is taking place? • What topics were noted or discussed in supplementary commentaries to the resource analysis?	How would you rate participants' (apparent) understanding of the approach adopted? ❑ Good ❑ Fair ❑ Poor Did it affect their treatment of the information in the analysis?
7. Completion of the analysis and assessment of the analysis results	• What are the linkages between indicators and variables utilized in the analysis (e.g. roads-> sedimentation -> water quality -> fish survival)? • How are these linkages explained? • How was this guidance provided to participants regarding the interpretation of analysis results? • Does the analysis provide implicit or explicit direction or alternatives for the mitigation of impacts?	How would you rate participants' acceptance and understanding of the linkages between analysis indicators and variables? ❑ Good ❑ Fair ❑ Poor How would you rate the usefulness of the guidance offered for the interpretation of results? ❑ Good ❑ Fair ❑ Poor

8. Presentation of analysis results	• How is quantitative and qualitative information utilized and presented in the resource analysis? • What discussion concerning analysis limitations and problems is included in the resource analysis? • In what spatial categories are results presented (e.g. by watershed, ecosection, management sub-units)? • Did the resource analysis present information relevant to the interests of the audiences and to the issues being addressed in the planning process? • Were the results of the resource analysis related to the broader environmental context?	How would you rate the presentation format used for the report? ❑ Good ❑ Fair ❑ Poor How would you rate the acceptance of the resource analysis results by participants? ❑ Good ❑ Fair ❑ Poor What were the key comments/reactions of participants to the report?
9. Application of the analysis results in the planning process	• Was the resource analysis delivered at the appropriate stage in the planning process? • Was it delivered in a timely manner (i.e. was the planning process delayed as a consequence of delays in completing the resource analysis)? • How did the resource analysis influence discussion of planning issues and decisions made in the planning process? If so, how? If not, why not?	How would you rate the effectiveness of the resource analysis in influencing/supporting decisions made in the planning process in a timely manner? ❑ Good ❑ Fair ❑ Poor
10. On-going use and adaptation (revision) of the analysis	• Does the approach taken to the resource analysis enable the development of new scenarios which may reduce environmental impacts? • To what extent was the analysis actually used for further scenario development? • Was the resource analysis methodology capable of responding to changes in information or queries and changes from audiences (i.e. iterative modeling capability — ability to "game" a variety of alternatives)? • Has the resource analysis been used subsequent to the implementation of the plan (e.g. for monitoring)?	How would you rate the effectiveness of the approach taken for use in subsequent scenario development ❑ Good ❑ Fair ❑ Poor

Some Additional Questions

Costs and time involved (efficiency)	• What were the costs of undertaking the resource analysis (in-house and contractor)? • How long did the analysis take to complete? What were the major factors that influenced the timeline? • What technical resources were needed to undertake the analysis (e.g. inventories, GIS work stations)? • What specialized staff or contractor skills were required (e.g. expertise areas, local knowledge, technical skill sets)?
Transferability	• What key aspects of elements of the approach to resource analysis adopted are transferable or applicable to other planning situations?
Learning from experience	• What advice would you have for others about to undertake a resource analysis? • Are there other ideas or comments you would like to add?

B. Documents Reviewed

The following documents provided the basis for the comparison of resource analyses:

- *Analysis of the Potential Effects of the Four Options Presented in the Kispiox Resource Management Plan to Fish, Wildlife and the Users of These Resources.* July 16, 1991. Prepared by G.L. Wolfe, Habitat Biologist, BC Environment Skeena Region.
- *An Analysis of the Community Resources Board and Inter-Agency Planning Team (CRB/IPT) Planning Table's Consensus Management Direction for the Bulkley Timber Supply Area: Comparative Multiple Account Analysis of Long-Term Projected Effects on Fish and Wildlife Habitat Resources: Base Case versus Consensus Management Direction.* March 1996. Prepared by Len Vanderstar, Acting Senior Habitat Protection Biologist, Skeena Region, BC Environment.
- *An Analysis of the Community Resources Board's Land and Resource Management Plan Options for the Bulkley Timber Supply Area: Comparative Analysis of the Long-Term Projected Effects on Fish and Wildlife Habitat Resources.* January, 1995. Prepared by Len Vanderstar, Forest Ecosystem Specialist, Bulkley Forest District.
- *Biodiversity Analysis of the Kispiox Resource Management Plan.* May 21, 1991. Prepared by B. Fuhr, Regional Habitat Biologist, Fish and Wildlife Branch, BC Ministry of Environment and Jim Pojar, Forest Sciences Officer, Prince Rupert Forest Region.
- *Environmental Indicators for Land and Resource Management Planning.* March 1995. Prepared for Ministry of Environment, Lands and Parks by Westland Resource Group.
- *Impacts and Risks of "Priority" Land Use Option (Kootenay/Boundary Regional Land Use Plan).* March 6, 1996. Prepared for and in cooperation with BC Environment Ministry of Environment, Lands and Parks by Kutenai Nature Investigations Ltd.
- *Kamloops Land and Resource Management Plan: Resource Analysis Report Summary.* August 4, 1994. Prepared by the Interagency Planning Team, Kamloops Land and Resources Management Planning Team.
- *Kispiox Resource Management Plan Socio-Economic Impact Assessment: Final Report.* July 1992. Prepared by Marvin Shaffer and Associates Ltd.
- *Kootenay/Boundary Regional Biodiversity Strategy: Draft Report.* September 1, 1995. Prepared for and in cooperation with BC Environment Ministry of Environment, Lands and Parks by Nanuq Environmental Consulting and Kutenai Nature Investigations Ltd.
- *Ministry of Environment, Lands and Parks Handbook for Land and Resource Management Planning (LRMP).* December 1995. Prepared by Land Use Branch, MELP.

- *Robson Valley Land and Resource Management Plan, Resource Analysis: Environment*. January 1996.
- *Strategic Direction for Habitat Protection*. March 1996. Habitat Protection Program, Ministry of Environment, Lands and Parks.
- *Vanderhoof Land and Resource Management Plan, Socio-Economic and Environmental Assessment of Consensus Land Use Plan*. Preliminary draft, March 1996. Prepared by Gary Holman and James Trask in cooperation with the Vanderhoof LRMP Inter-Agency Planning Team.